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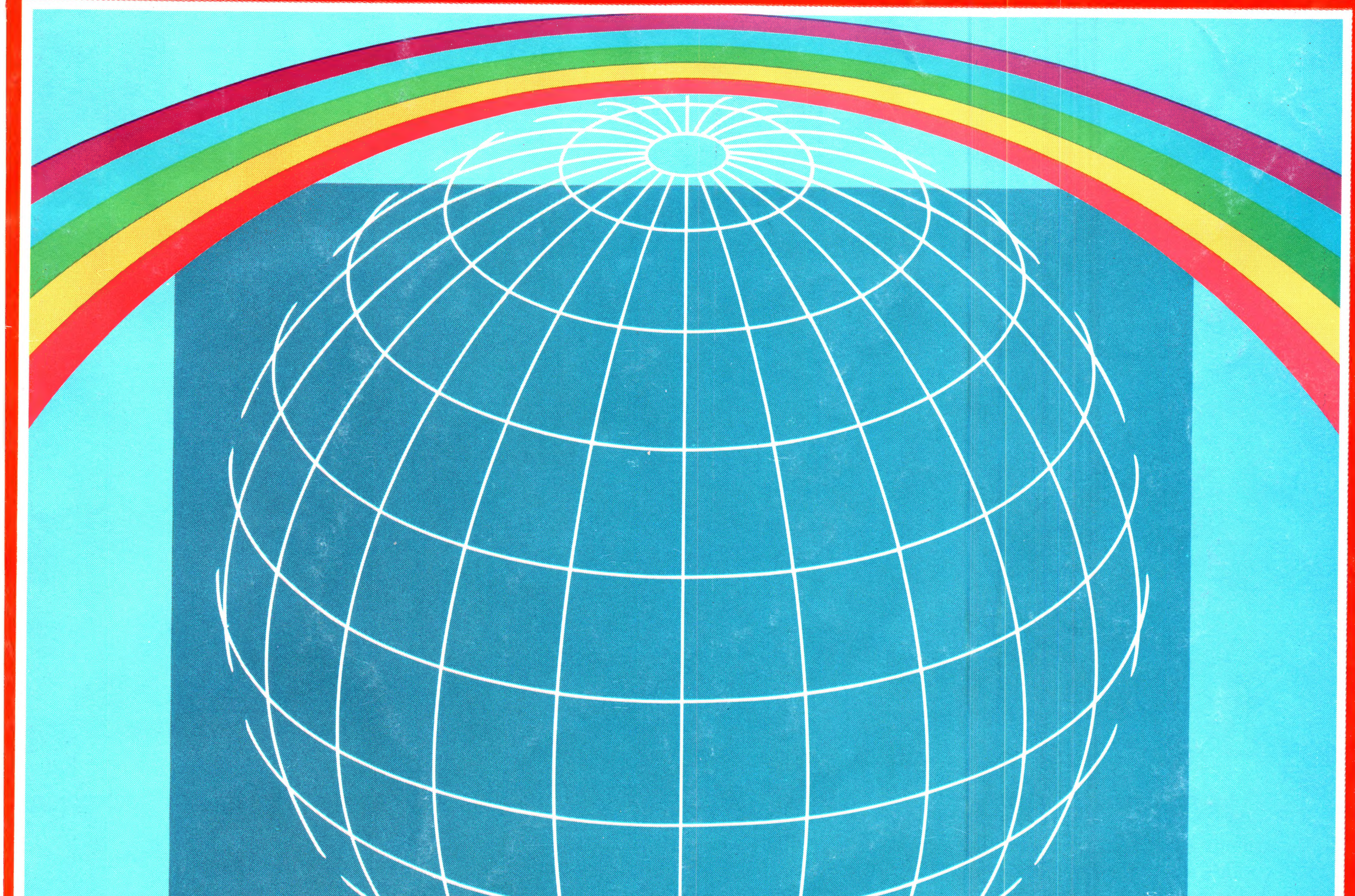

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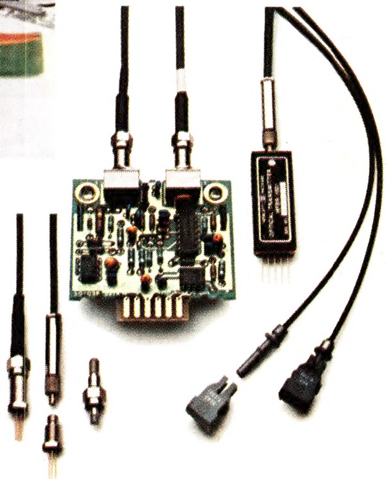

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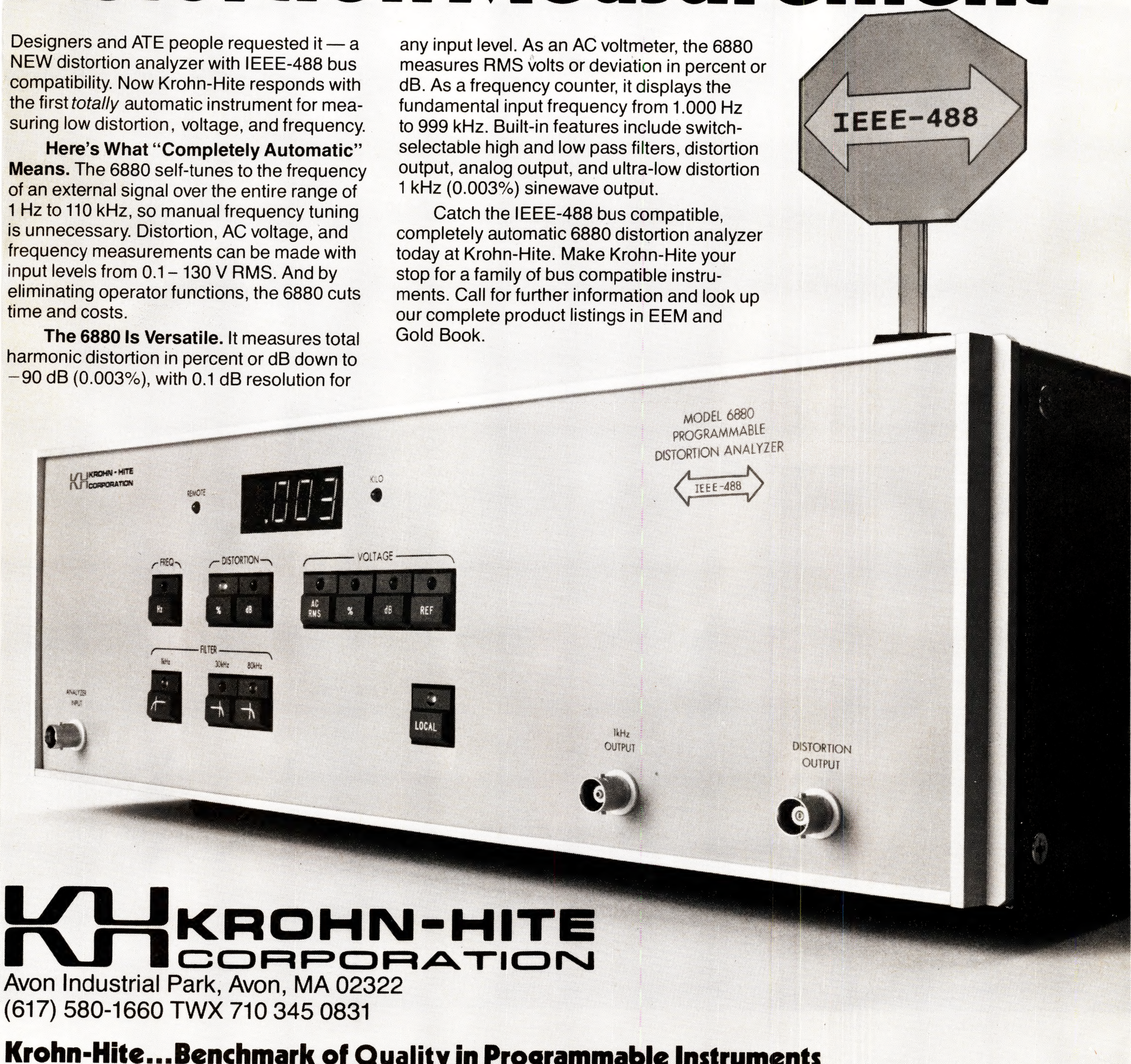

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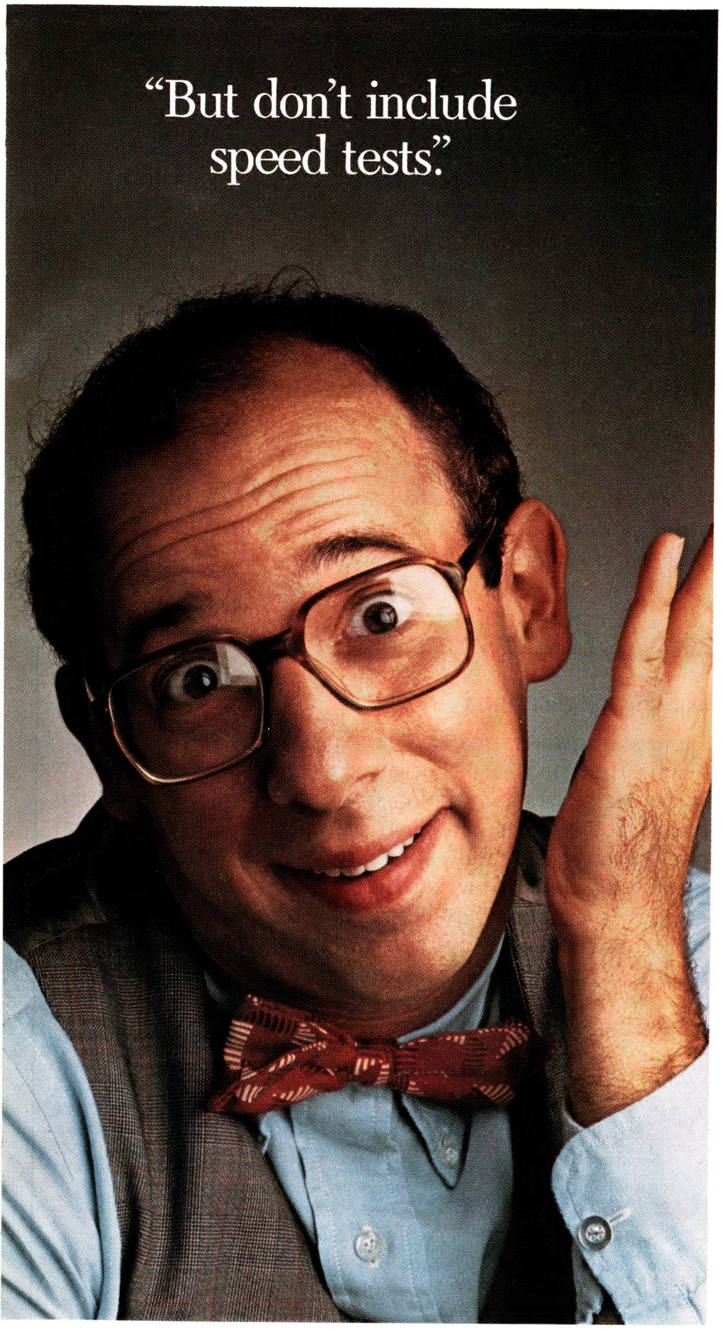
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The new performance standard.

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No other 32-bit MPU makes this extensive a leap in performance improvement. At 16.67 MHz the MC68020 typically runs at 2.5 MIPS for integer processing. MIPS rates several times typical are achievable in dedicated 32-bit applications.

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A fully compatible M68000 Family member.

Yes, the MC68020 has features new to the M68000 Family to maximize its true 32-bit capabilities.

Yes, it's an all new design built with advanced, highly manufacturable HCMOS technology.

And, yes, it's a fully-compatible member of the M68000 Family of MPUs and peripherals. All user object code written for previous M68000 Family MPUs executes without revision. In fact, MC68020 enhancements allow it to run more than three times faster.

Family compatibility is further enhanced by dynamic bus sizing, which supports the use of 8-, 16- and 32-bit ports in 68020-based systems. In fact, the MC68020 can be used in existing 8- or 16-bit systems.

New features enhance 32-bit architecture.

The MC68020 design is new, however its architecture is based on the proven M68000 Family 32-bit register set. And, the MC68020 is highly enhanced.

On-board instruction cache speeds operation and provides increased multiprocessing efficiency. The coprocessor interface allows direct expansion of the architecture off the MC68020 chip to coprocessors or customer-specified processing systems.

New addressing modes, new instructions and a 32-bit barrel shifter support new capabilities. Operating system efficiency is improved with a 32-bit program counter.

These enhancements and more optimize the MC68020 for 32-bit operations.

Design support brings projects together, fast.

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Move up to the MC68020.

The opportunity to design new-generation systems around the MC68020 and the M68000 Family is yours today. Marketplace attention will be focused directly on the growth-oriented companies that take advantage of this opportunity. Motorola's sales engineers and field applications specialists are available and equipped to assist you in moving up to the new 32-bit microprocessor performance standard. Contact one of them today.

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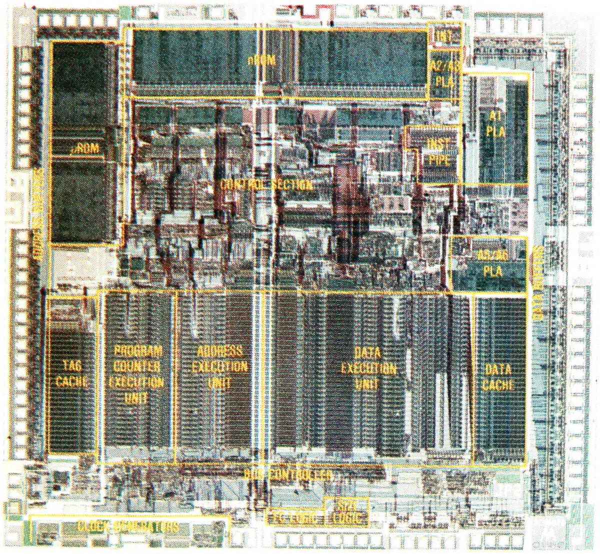

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Reference: Optocouplers

"Quadrupeds" win 3-2 on space

With its four pins the new Siemens SFH 610 optocoupler is quite unlike any of its predecessors in a DIP-6 case. And its smallness gives it an enormous

space advantage: now you can fit three couplers where there used to be room for only two.

Thus you get the packing density of multiple couplers, but without any of their so hard to avoid problems with non-uniform current transfer ratio.

A big bonus in return for a small sacrifice: we've done away with two inessential pins (can you remember ever wiring the base pin?). Otherwise the new four-pin models offer the same proven technology as the SFH 600 family:

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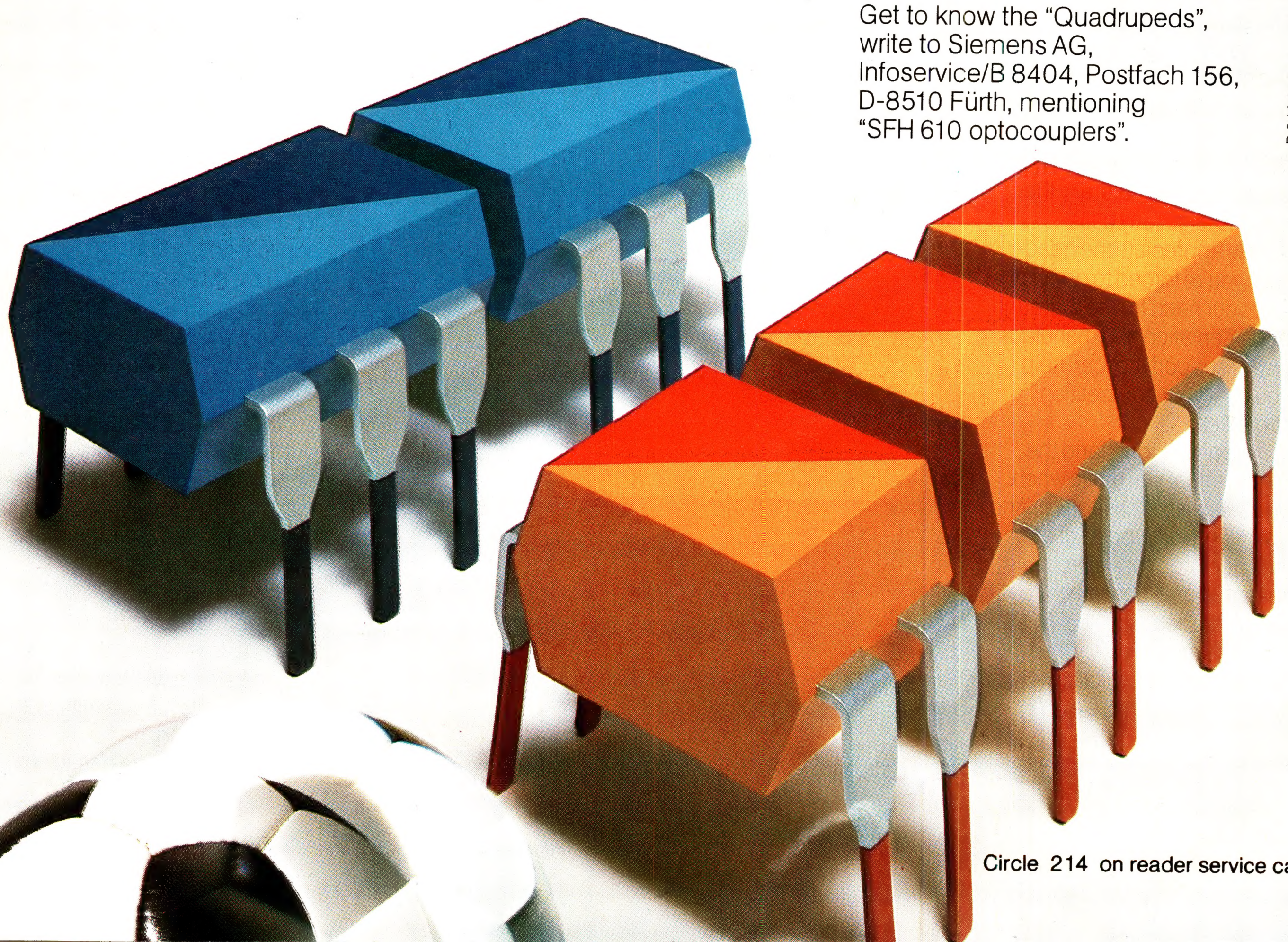

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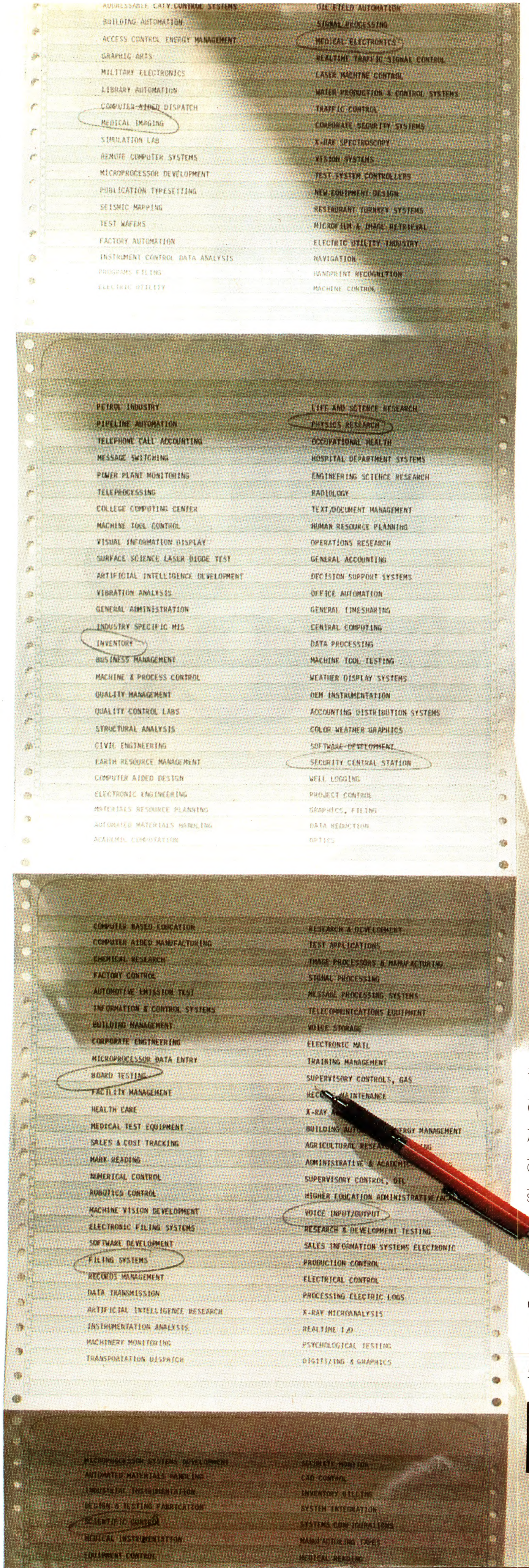
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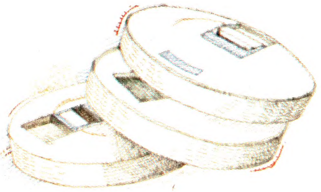

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FAST PLA CHIPS FOR COMPUTERS GO TO MARKET

User-programmable parts with propagation delays of 15 ns should supplant fast TTL in speed-critical data paths

☐ *by J. Robert Lineback*

Dallas

Don't hoard fast bipolar logic chips: They seem destined to be supplanted by user-programmable logic arrays, now reaching 15-ns maximum propagation delays. At such levels, the new programmable arrays are expected to begin appearing in speed-critical data paths of fast computers, taking over from small- and medium-scale bipolar logic components.

First out of the gate with 15-ns PLAs is Dallas-based Texas Instruments Inc., which only a year ago entered the user-configurable logic market by second-sourcing PAL circuits from Monolithic Memories Inc. of Sunnyvale, Calif. Early this month, TI quietly began shipping what it says is the industry's fastest 20-pin PLA to distributors. This week, the firm is announcing the availability of the TIBPAL16L8-15 at $5.18 each in 25,000-piece quantities.

Relying on a new version of its most advanced 2-μm oxide-isolation bipolar technology (see "Wafer-stepping gains impact TI's Impact"), TI hopes to rise quickly from the status of newcomer to dominant supplier in programmable-logic markets, which by most accounts will reach worldwide sales of $200 million in 1984. Growth rates are expected to exceed 30% a year, and many believe the business will easily reach $1 billion by 1990.

After delaying introduction last spring, National Semiconductor Corp. of Santa Clara, Calif., now says it will begin shipping 15-ns PLAs within a month. National has developed its own oxide-isolation bipolar process, derived from emitter-coupled-logic memories and modified for higher breakdown voltage. This technology, plus an addition to a modified circuit design, makes the PLA chips suitable for replacing up to 10 advanced Schottky components, says Joseph Vithayathil, strategic marketing manager. Some customers have already received samples of the 20-pin circuits.

Other firms are also hot on the trail of faster bipolar parts. Advanced Micro Devices Inc., Sunnyvale, Calif., intends to push its fastest speed offering from 20 ns to 15 ns in the first quarter of 1985. AMD is already producing 20-ns

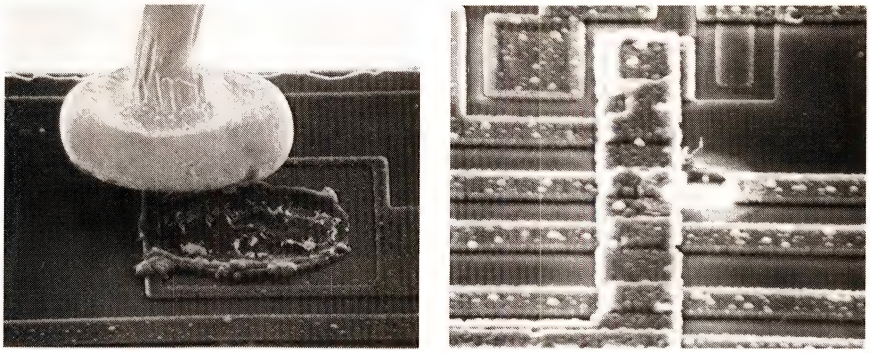
Wafer-stepping gains impact TI's Impact

Advances in production equipment can open the door to changes in semiconductor technology, but the evolution of manufacturing systems can also delay or even eliminate the need for new processing techniques. Take Texas Instruments Inc.'s most advanced oxide-isolation bipolar process, called Impact: implanted advanced composed technology.

When first developed in the early 1980s, Impact combined conventional projection printing with emerging wafer-stepping lithography. The process represented a revolutionary departure from TI's existing advanced low-power Schottky technology. It was designed to drive bipolar features below 2 μm, while minimizing the number of critically aligned mask steps, which had to be handled by very accurate but slow wafer steppers. Oxides were grown instead of removed.

Enhancements in wafer-stepping equipment that boosted throughput 24 times and a general movement to 6-in. silicon slices have eliminated the benefits of the changes. Instead, wafer-stepping lithography and new design rules will be used in all levels of the existing ALS process, now at the 3-μm level for TI's ALS and advanced Schottky logic components.

The result is a new but more conventional 2-μm Impact that almost achieves the bipolar performance of the revolutionary process. For starters, the new Impact is being used on TI's new high-speed programmable logic devices and programmable read-only memories. However, the original Impact, which still has 4-μm metal pitch features (the new Impact has 7-μm) is still being used to prototype TI's AS888 and 889 8-bit bit-slice devices. TI is now considering converting the bit-slice processors to the new Impact for processing standardization. The new Impact represents little change to the processing front end from ALS and LS. The difference is that wafer stepping has totally replaced projection printing, and transistors are 1.05 mil^2 instead of 1.94 mil^2. **–J.R.L.**



Fault finders. Hughes' tests more than a million semiconductor parts per year. At last report, 4,700 parts per million had defects like lifted thermal bonds (left) and multilayer shorts.

with their Japanese competition [*Electronics*, April 10, 1980, p. 81], the study spurred improvements that continue to this day, bringing virtual parity in quality between the two countries.

Also working against any change in the military-component status quo is the bureaucratic nature of the mil specs themselves, which have evolved into a nearly impenetrable thicket of requirements. Many industry participants, in fact, feel that they work somewhat at cross purposes. On the one hand, the extreme difficulty of changing mil specs stymies the sort of fast-moving innovation that characterizes commercial semiconductors. On the other hand, by living up to the letter of the specifications, both suppliers and customers are shielded from any blame if the end equipment falls short in performance in the field.

High failure rate. Compared with many such studies in the merchant market, the results of extensive military-chip testing are seldom made public, so the very high failure rates spotlighted in extensive programs become especially interesting. In one project, began in the late 1970s at Hughes Aircraft Co.'s Radar Systems Group and continuing today, the avionics manufacturer has been retesting more than 1 million parts a year under the applicable mil spec (see table, opposite).

The Hughes group, which has more than $800 million in annual sales to the military, sometimes performs these retests on every component used in an entire program; in others, it only samples them. The cost of the program, which runs to some $2 million to $3 million a year, is partly borne by Hughes; the remainder is charged to the programs. The Hughes managers say that pursuing a nonmandated test program of this magnitude is the only way the performance of the end system can be assured.

The Hughes failure rates are far and away higher for its military-designated components than for its commercial products. In the latest 1984 period, the rate amounted to 4,700 parts per million, more than 10 times what major semiconductor firms are currently reporting for their entire lines. (Hughes itself does not compile a composite failure rate, citing the lack of a sufficient statistical base, but does report results quarterly to each of its suppliers. The company also does not single out offending parts, merely noting that "all of them have had their problems at one time or another.")

Interestingly enough, according to most process experts, commercial and military integrated circuits are essentially the same, separated only by the documentation that must be generated to ensure traceability. The overriding questions concerning the Hughes results, therefore, are not only why the failure rate is so high in retesting chips that have already run the mil spec gauntlet but also why they fail at a rate so many times higher than their commercial counterparts do. After all, the trend has been for commercial users to do more testing, largely under the impetus of automobile builders and computer manufacturers, whose quality demands in many cases actually exceed military requirements.

Varied explanations. As might be expected, explanations for the poor results of military quality testing vary greatly, depending on which quality-control official is doing the talking. Indeed, such officials commonly express surprise that their competitors are having problems that, of course, have been solved at their own companies. But universally, they raise a question about the repeatability of test procedures—the question of whether the user (that is, Hughes) exactly duplicates the equipment and calibration of test equipment performing the first tests at the semiconductor plant.

Calibration alone is a major task, aligning what is an array of many types of test equipment to common standards with the manufacturer. Also, a misstep with something as basic as nonstatic gear can alone account for failures in the 1,000-to-3,000-ppm range. "If you don't have nonstatic equipment at all, that's 10,000 ppm right there," remarks Derek Lidow, vice president of operations at International Rectifier Corp., El Segundo, Calif., which is located near the Hughes radar facility. He also notes that mishandling chips for manual testing can cause a 3,000-ppm rate.

Also, the stringent temperature ranges (–55 to +125°C) imposed on military chips forces many failures in parts that might pass the 0-to-70°C commercial standard. Merrill F. Johnston, who heads the Hughes Radar Group's Manufacturing Reliability Laboratory, confirms that very high temperatures often turn up malfunctions, leakages, and breakdowns that would otherwise slip through. He says his group puts failed chips through a 12-step analysis and makes this data available to the vendors so that they can use it to make the corrections.

But it is a mistake to assume that mil spec products are inherently better than commercial ones, says David S. Cochran, a former semiconductor process consultant who now oversees buying chips for Xebec Corp., Sunnyvale, Calif. In Cochran's experience, "commercial devices are as good as military ones." In fact, he says, "At some places, commercial quality doesn't seem to be getting to the military side of the house."

This is a frequent observation, especially from chip manufacturers who attribute the problem to red tape involved in changing MIL SPECs. An example is quality assurance procedures required by automo-

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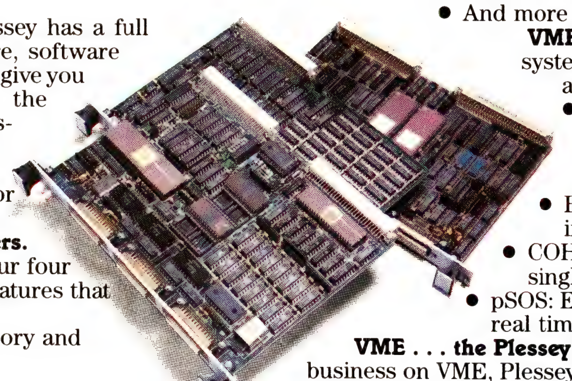

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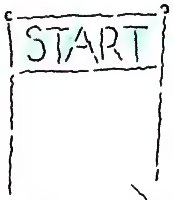

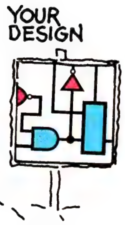

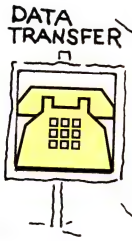

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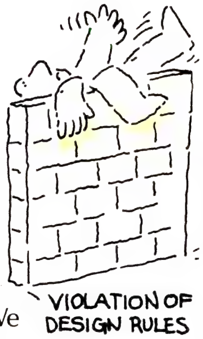

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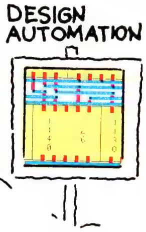

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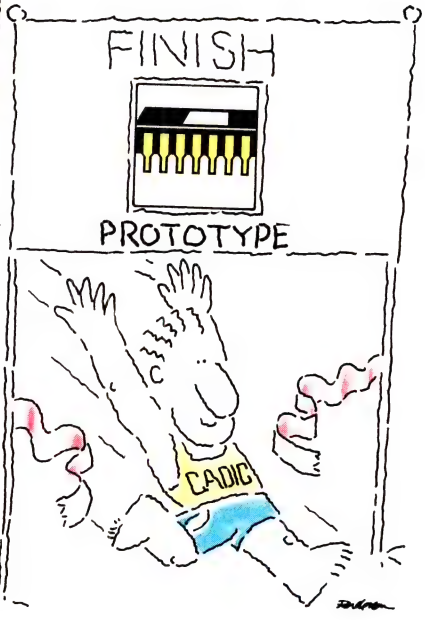

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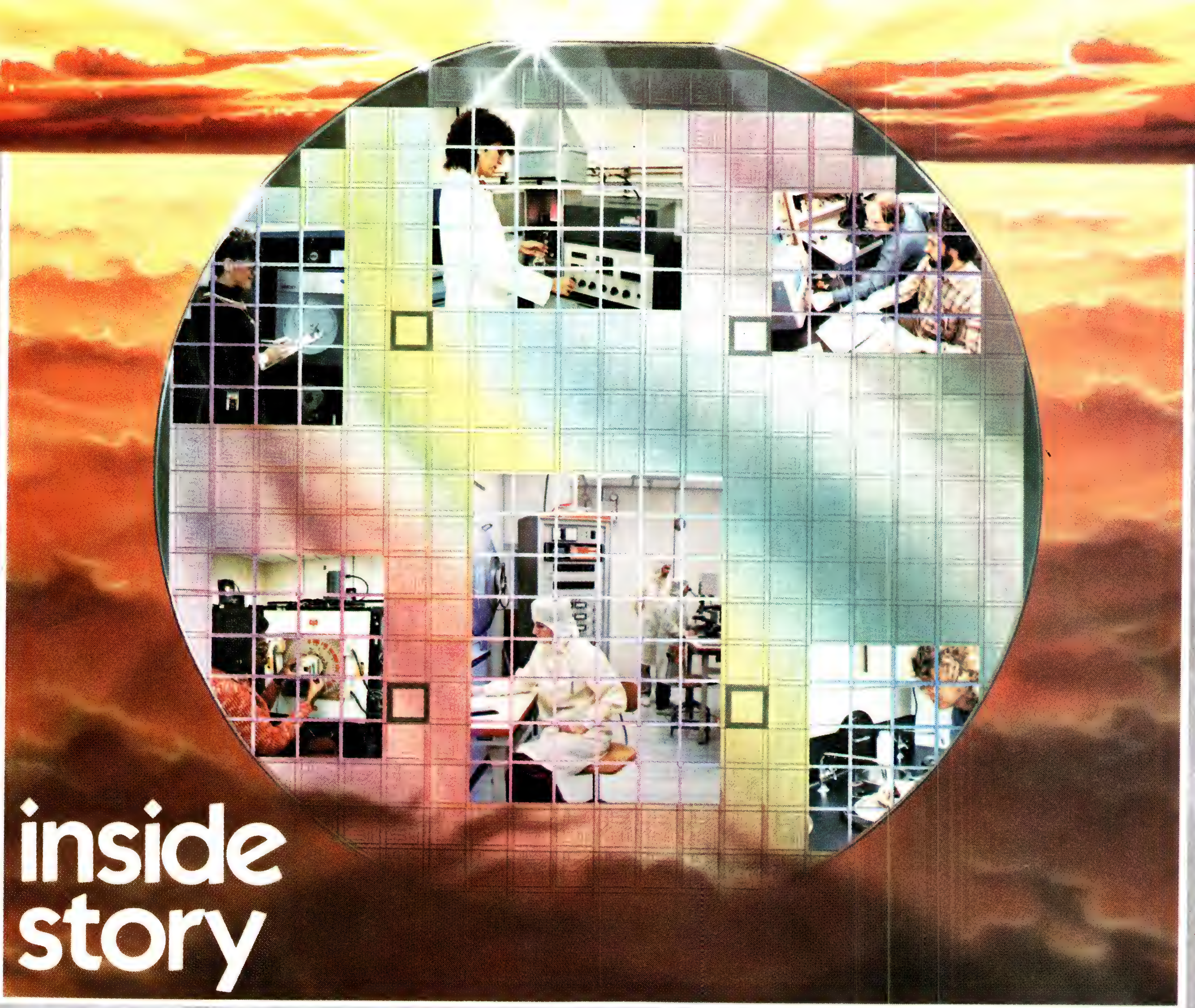

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One reason for this faster speed is code efficiency; most MK68200 instructions are just one word. That not only saves code space, it also improves execution speed. And the powerful instruction set incorporates more than 50 instruction types which operate on both byte and word operands.

Next, look at the available versions. The MK68200 comes in a 48-pin DIP with 0 or 4K bytes of ROM and 256 bytes of RAM. It is expandable to address a full 64K byte address space externally. And finally, an 84-pin LCC version (with no ROM), is available for system development or for multiple bus applications.

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UNITED TECHNOLOGIES
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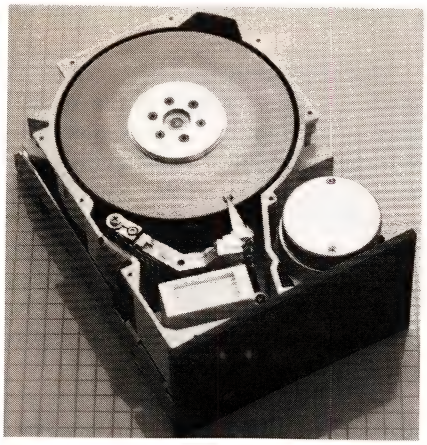
Jose, with the 85-megabyte V185. Control Data Corp., a major producer of big disks, plans to have its 86-megabyte Wren II by year end.

At the lower end of the capacity spectrum, Quantum Corp.'s Q500 Series has a 40-megabyte drive that employs a less advanced technology than its competitors. The Milpitas, Calif., firm reports brisk business and is already turning the drives out in quantity. Computer Memories Inc., Chatsworth, Calif., also announced 60- and 80-megabyte drives at NCC: the CM7000 Series, which does not use the advanced closed-loop voice-coil technology.

Penetrating. *Disk Trend*'s Porter believes the new drives will achieve little market penetration this year but thinks that 60,000 to 70,000 will be built in 1985. For 1986, he expects more than 100,000, which is roughly equivalent to 500,000 personal computers, since the drives will be used for multitasking. The present price range of $1,000 to $1,900 will probably come down as larger quantities are delivered later on.



In high demand. Sales of small high-capacity Winchester drives—like this 5¼-in., four-disk, 80-megabyte drive from Computer Memories—are ready to soar.

Even with the 85-megabyte drives not fully established, NCC reports signalled the next product wave. At November's Comdex show, Germany's Siemens plans to unveil a 300-megabyte drive that will be produced next year. –**Larry Waller**

COMPUTERS

Japanese fifth-generation program clicking along right on schedule

Tokyo—A little more than two years after they embarked on their flight into the unknown, Japanese computer experts are smack on their original schedule to develop the knowledge systems for their fifth-generation computer, due in the 1990s. They are well along on studies for the knowledge-information-processing system, using a parallel inference machine, and on a knowledge-base machine that they should finally assemble during the three years from 1989 through 1991, following a four-year intermediate stage—due to start next April—devoted to studying reduced-scale subsystems.

Knowledge information processing systems are designed to process knowledge—thus their use in what is known as artificial intelligence—rather than to crunch numbers, like today's computers. Unlike mathematics, relationships based on knowledge are not completely black and white. Thus machines are needed that must make inferences from knowledge in the same manner as humans. A parallel inference machine uses parallel processing, a non-von Neumann architecture [*Electronics*, Nov. 3, 1983, p. 136].

Custom tools. Because the project is a bootstrap operation, an impressive array of tools is being developed for designing and simulating the software and hardware for the intermediate stage. During each phase, researchers simultaneously plan hardware and software for the following phase and fabricate the tools they will need to implement the plans.

Although the project is definitely on course, midstream corrections may be needed because of its large and relatively unforeseen impact on both the Japanese and world computing communities. Japanese researchers feel a need for a stronger infrastructure in Japan and for greater cooperation with those involved with similar projects in the U.S., the UK, West Germany, France, and the rest of the European Communities. That feeling should be made more explicit at the upcoming International Conference on Fifth Generation Computer Systems, to be held in Tokyo, November 6 through 9.

Further along. Japanese researchers will have more to talk about than they did during their first international conference three years ago [*Electronics,* Nov. 17, 1981, p. 83]. Then, the project was just being organized and called for a Digital Equipment Corp. 2060 mainframe running Prolog to develop software for the pilot model.

Now, the Institute for New Generation Computer Technology (ICOT) is already operating several copies of PSI, a personal sequential inference machine that runs Prolog as fast as a DEC 2060 mainframe [*Electronics,* July 28, 1983, p. 101]—although it, too, is only a pilot model for software development (see "Pilot hardware revs up to speed," p. 34). Back-end processors on order will increase speed another three to five times. A newly developed relational data-base machine, called Delta, linked to a gradually increasing number of PSIs by a local network, provides the data base needed for software development work and simulation of knowledge applications.

The kernel language for PSI, KL-0, is a firmware-interpreted Prolog-like language that serves as the native machine language. The system-implementation language is ESP, for Extended Self-contained Prolog, which is used to write Simpos, the Sequential Inference Machine Programming and Operating System. ESP is a logic-programming language on the program-statement level but is object-oriented on the module level. It is designed to provide an excellent programming environment with a compact operating system suitable for system expansion.

PSI and Delta are the base from which will be developed the intermediate-stage KL-1 kernel language for the parallel inference machine and knowledge-base machine. The eventual user's knowledge-programming system language, Mandala, is being

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that there is a real need for 8-mm VCRs at present. Their Betamovie and VHS movie single-unit camera-recorders, or camcorders, are no bigger than the first 8-mm ones and feature tape compatibility for playback on standard home VCRs. Sony is supplying its camcorders to other Beta-group firms on a private-label basis; Victor is negotiating with other manufacturers in the VHS group.

Sony's Beta VCR uses a standard full-length Beta cassette, though the charge in its rechargeable battery is insufficient to record long tape. Victor features a small 20-min cassette that snaps into an adapter for playback on standard VHS VCRs. The firm claims that this is more than sufficient for most live recording applications. **–Charles L. Cohen**

MEMORIES

Military sales expected to boost EE-PROM market

Chicago—As electrically erasable programmable read-only memories start to hit 64-K density levels, some suppliers are confident that an expected increase in military use of the parts will finally make sales soar. To date, EE-PROM sales have been slow, largely because the chips are not standardized and come with an average selling price 5 to 10 times higher than those of E-PROMs.

The military particularly wants EE-PROMs for weight- and space-sensitive avionics applications that cannot incorporate current-generation 16-K parts. It "has several large programs with production requests beginning in January," says David Starr, group product marketing manager at Advanced Micro Devices Inc., Sunnyvale, Calif., one of three vendors currently shipping 64-K parts. He expects the military to use the devices in quantity and thinks that learning-curve price reductions will later attract larger commercial volumes. In October, Seeq Technology Inc., in San Jose, Calif., will start shipping the 52B33A, a version of its 64-K device that will meet extended military temperature requirements of –55 to +125°C. Expected applications include flight and crash recorders, terrain-mapping systems, satellite navigation gear, and electronic countermeasure equipment.

Promising market. Estimates of the military market potential vary widely. One of the most optimistic comes from NCR Corp., where Walter Krysiak, an official in the nonvolatile memory operation, believes that military applications could account for about half of a $300 million market for high-density EE-PROMs (both 32-K and 64-K) next year. In fact, the military business looks so promising that NCR's Microelectronics division, in Miamisburg, Ohio, is reversing the normal introduction cycle by starting with a military version of its 64-K part, the HR 52864; this month, sample deliveries will begin for chips in a 28-pin ceramic dual-in-line package or a 32-pin leadless chip-carrier.

NCR is at least the fifth supplier to push some 64-K parts out the door, after AMD, Seeq, and Xicor Inc., Milpitas, Calif. Those three claim to be in small-volume production using a floating gate n-channel MOS technology. Inmos Corp., Colorado Springs, has supplied samples of parts built with its competing Nitrox technology, similar to the silicon nitride oxide process that NCR uses. Inmos memory applications manager Fred Jones says the firm plans to have samples of a reworked version of its IMS 3630 this fall. The first versions are aimed at the commercial market, with military-grade parts to follow in about six months.

Few vendors share NCR's level of optimism, but most agree that military sales are likely to grab a growing portion of the overall market next year. At Seeq, for example, Daniel McCranie, marketing and sales vice president, thinks that 1985 military sales by all vendors will account for more than half of a total EE-PROM market amounting to some $100 million, up from about a 30% share of a $45 million market this year.

San Jose market research firm Dataquest Inc. also projects accelerating EE-PROM sales, although it does not break out military-versus-commercial comparisons for end use. This year's 64-K sales will account for about $30 million of a worldwide market of $190 million, says Stan Bruederle, director of the firm's semiconductor information service. Bruederle expects that next year, the total market will jump to $373 million, with 1986 industry sales hitting $583 million.

Growth hindered. Currently available EE-PROM parts generally conform to the Joint Electron Device Engineering Council's pin-out standards for byte-wide organized devices. But some chips incorporate self-timing, while others require externally supplied timing signals. Different parts allow varying amounts of data—from 16 to 64 bytes—to be written into a device in page mode during a single write cycle. Other variations concern the methods used to notify the system microprocessor

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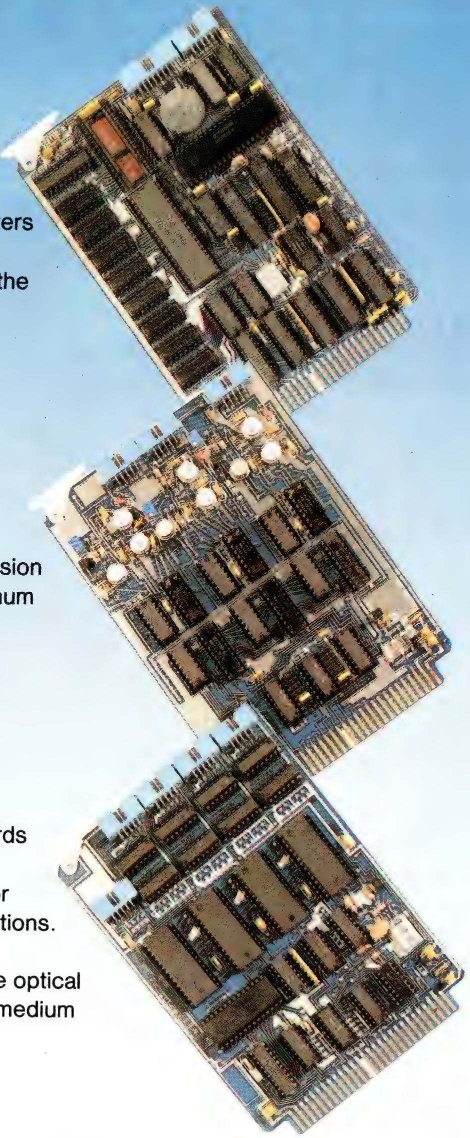

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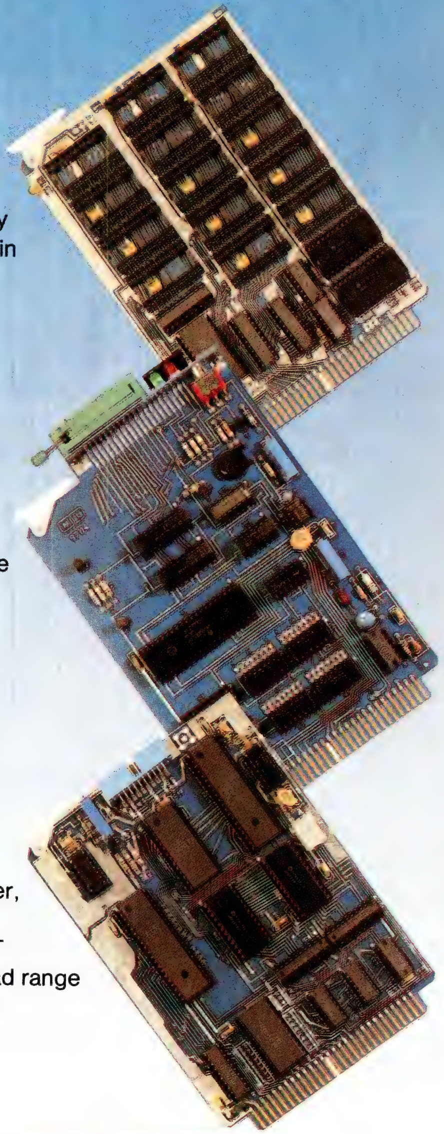

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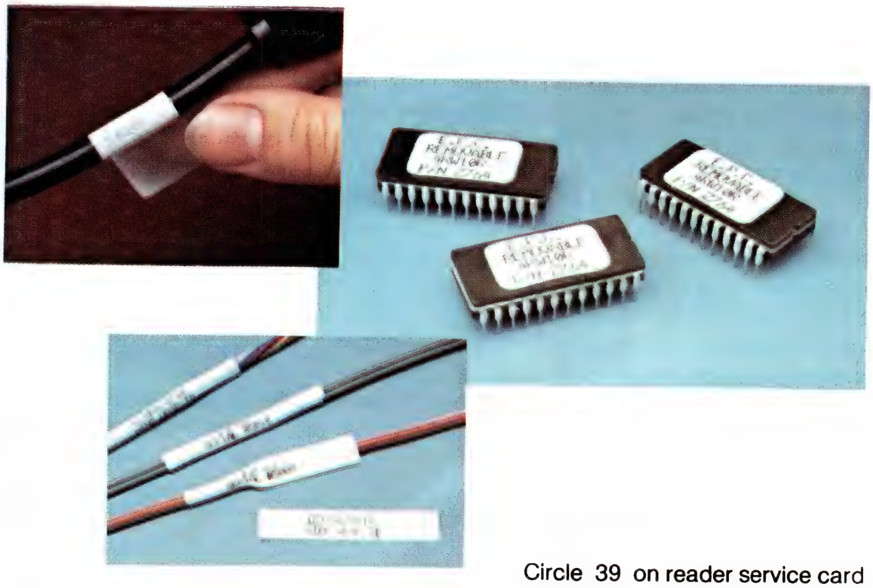

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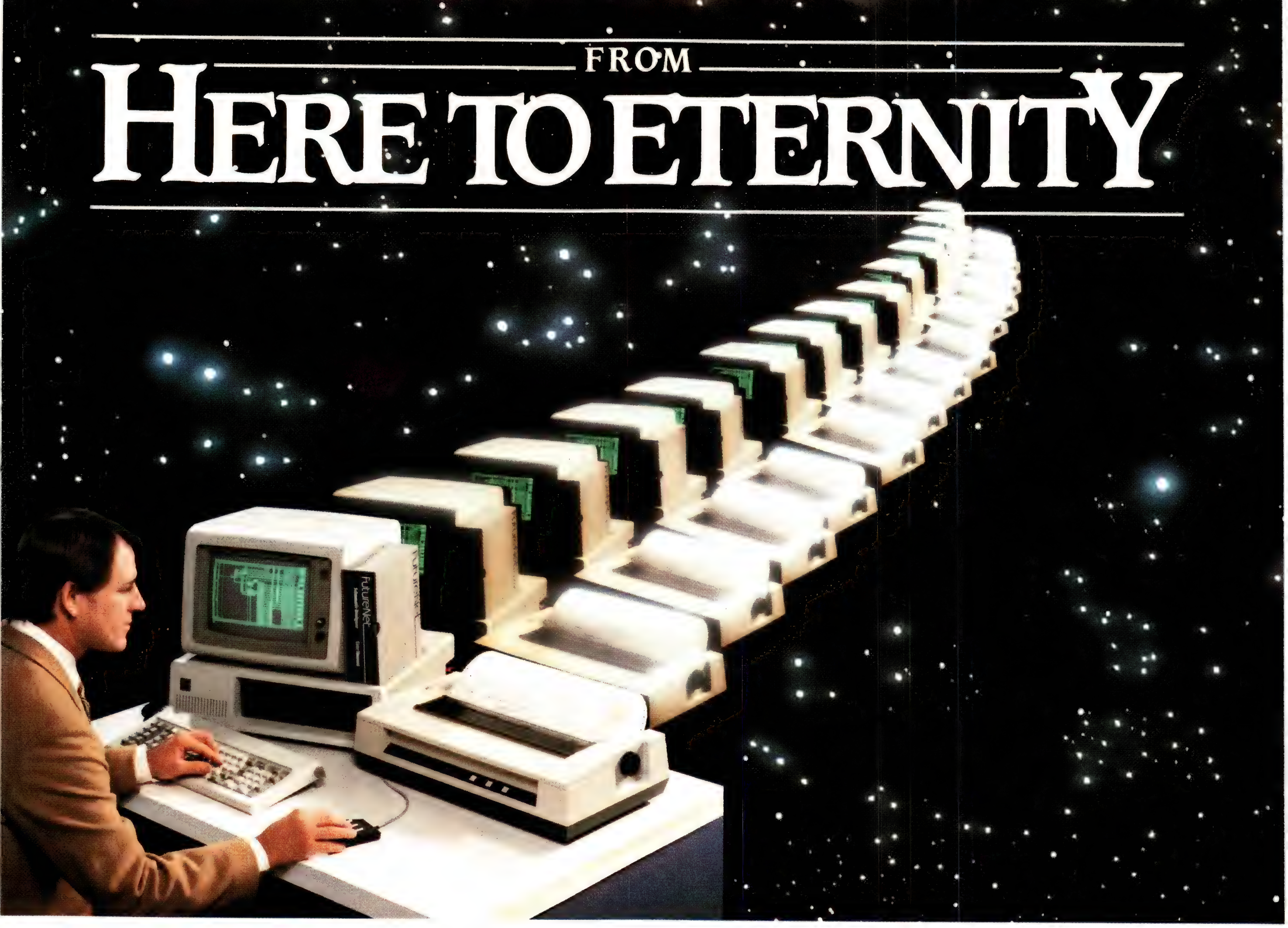

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Circle 41 on reader service card

NUMBER 131

ALL-SOLID-STATE 10kW VHF TV TRANSMITTER.

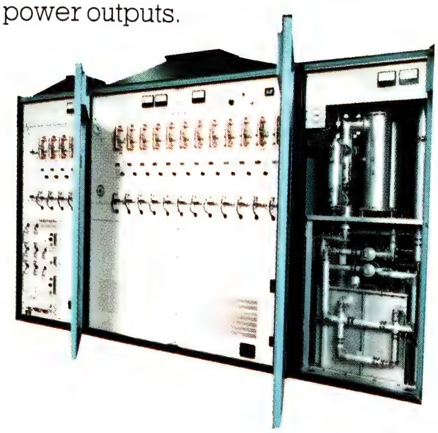
Today's most powerful all-solid-state VHF TV transmitter is available from NEC.

The 10kW transmitter incorporates diverse new technologies. Advances include high-efficiency high-power transistor amplifiers, low-loss RF combiners, high-efficiency switching regulators and a high-performance exiter. It has 12 transistor power amplifier units working in parallel in the video section and 4 such units in the audio section. These feature greatly reduced component counts. A rubidium oscillator is used in conjunction with a synthesizer to assure extra stable carrier frequencies.

Compared to tube types, the new all-solid-state transmitter offers many advantages including extra-high reliability, easy maintenance, unattended operation and complete safety.

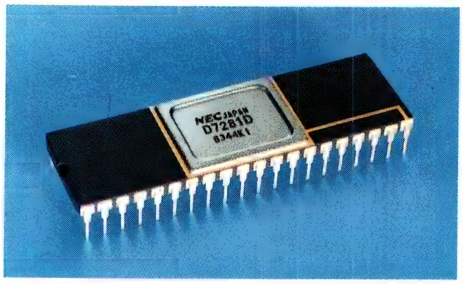
The first unit was delivered a year ago and it continues to demonstrate satisfactory performance.

NEC also offers all-solid-state TV transmitters with 1kW, 3kW and 5kW power outputs.



NON-VON NEUMANN IMAGE PIPELINED MICROPROCESSOR

Image processing demands repetitive high-speed operations on enormous amounts of data. To perform this task with maximum efficiency, NEC has developed the μPD7281D, the world's first non-Von Neumann type microprocessor with an amazing speed of 5 MIPS*. For processing an image of 640 × 400 pixels, it can rotate pictures or graphics freely to any angle at a speed of 1.4 seconds*.



By drastically reducing cost and size of image processing hardware, the new VLSI can add attractive features to CAD systems, facsimiles, copiers and other office automation equipment.

The μPD7281D is also well suited for high-speed signal processing and numerical calculations—for products such as digital filters, robots and NC systems.

The new VLSI features ☐Data-flow and flexible 5-block circular pipeline architecture. Different computations are independently 'data-driven' within the 5 blocks. ☐Separate input and output buses. ☐On-chip 16 × 16 bit multiplier. ☐200 ns* pipeline cycle for all operations. ☐32 PU instructions including barrel shift, bit operation and bit check. ☐Easy formation of multi-processor system for faster execution. ☐Support LSI soon to be available to interface the μPD7281D with host processor and memory. ☐Easy software development with flow graph, functional assembler and simulator.

*Target figures.

WORLD'S LARGEST LOCAL DIGITAL EXCHANGES IN SYRIA.

The world's largest-scale local digital exchanges are now in service in the Syrian Arab Republic.

The two NEAX61 multiprocessor digital switching systems in Damascus, the capital, and Aleppo accommodate 40,000 subscriber lines each. At the same time, another 20,000-subscriber line NEAX61 system was also put into service in Damascus, a model city selected by CCITT for telecommunications network digitalization.

Another feat achieved by NEC in the project was to carry out changeover from the existing systems (about 20,000 subscriber lines) overnight.

In addition to the switching systems, NEC has also delivered a total of 145 information service consoles and assistance service consoles.

NEC
NEC Corporation
Tokyo, Japan

result of contention for shared memory and other kinds of system overhead.

Cray's Dungworth notes that the X-MP design includes a number of hardware and software features designed to overcome such problems. To minimize contention, for example, the X-MP/48's 8-million-word (64-bit) shared bipolar emitter-coupled-logic main memory has been arranged in 64 interleaved banks. Cray will also provide special Fortran library routines that will allow users to partition programs into independent tasksand to synchronize the execution of programs. In benchmark tests run on an X-MP/48 system already installed at Cray's Mendota Heights, Minn., development facility, the four-processor system has run at speeds up to 3.8 times those of single-processor X-MPs, Dungworth notes. Such speeds indicate that the loss of efficiency is minimal.

Down the road, probably after 1986, Cray is planning to offer a compiler that will perform program segmentation of Fortran code automatically, much as the company's current-generation compiler performs automatic code vectorization.

Driving. To complement the new machine's higher speed, Cray will also provide a new disk drive product known as the DD-49, which will be supplied on an original-equipment-manufacturer basis by Ibis Systems Inc., Westlake Village, Calif. With a 1.2-gigabyte capacity and a transfer rate of 10 megabytes/s, the new drive offers twice the capacity and 2.5 times the effective speed of Cray's current-generation DD-29 disk drive, supplied by Control Data. Featuring a thin-film disk technology and a conventional ferrite monolithic head, the DD-49 will be offered only on the X-MP/48 and will not be sold with one- or two-processor X-MP systems. This restriction could help head off capacity problems with the new drive, since there is currently no alternate source for the Ibis-built unit, Cray officials concede.

The X-MP/48 will accommodate a maximum of 32 of the new drives, for up to 38.4 gigabytes of secondary rotating storage. An additional gigabyte of secondary random-access MOS memory can also be added using a new model of Cray's solid-state storage device, a unit that can be connected to the X-MP/48 through two high-speed channels offering a combined transfer rate specified at a blazing 20 gigabits/s.

Prices for the X-MP/48 will start at $14 million. Also available will be two-processor models and single-processor versions, whose prices start at $5 million. –**Wesley R. Iversen**

INDUSTRIAL

GM, Boeing unveil links for local nets

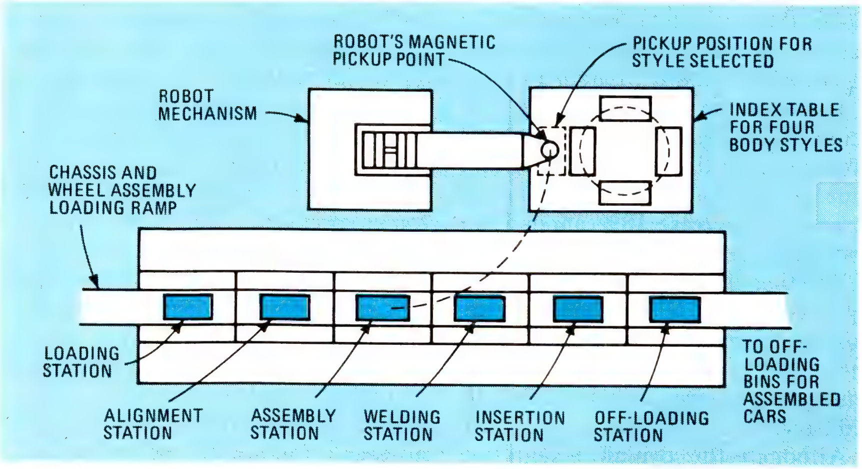
Las Vegas—The National Computer Conference, July 9-12, was by and large a ho-hum affair, but two eye-opening demonstrations of open systems interconnection for local networks were exceptions. Instigated by the National Bureau of Standards, one for factories was promoted by General Motors Corp., and the other for the office was hosted by Boeing Computer Services Co.

Besides the demonstrations [*Electronics*, May 31, 1984, p. 78], GM added some thunder by announcing support for a set of manufacturing automation protocols, or MAP, that is expected to greatly reduce the time involved getting standardized automation gear to the shop floor. GM's allies in the effort to organize a users' group to quicken the pace of shop-floor communications standardization are Boeing, McDonnell Douglas, Kodak, DuPont, and more than 30 other industrial manufacturers.

Faced with the problem that GM characterizes as islands of automation—where robots and programmable controllers at one site are unable to communicate with other automation sites—GM developed MAP as the baseline document in its procurement process to enforce communication standards. The hope is that establishment of the de facto factory standard will encourage subsystem vendors to push ahead, rather than wait out the ponderous approval procedures of world and national standards-approving bodies.

Fast-moving. The two demonstrations proved just how quickly the standardization juggernaut is moving. Under the auspices of Boeing Computer Services, a division of the Seattle aircraft maker, eight businesses—Advanced Computer Communications, Charles River Data Systems, Digital Equipment Corp., Honeywell Information Systems, Hewlett-Packard, ICL Ltd., Intel, and NCR—swapped files and moved videotex data across an IEEE-802.3 carrier-sense multiple-access net with collision detection, using the class 4 transport protocols that have been approved by the International Organization for Standardization (ISO).

In the GM demonstration, an IEEE-802.4 token-bus network used the same internationally accepted transport protocols to provide the flow control and error correction to six devices from Allen-Bradley, Concord Data Systems, DEC, Gould, HP, IBM, and Motorola. The six pieces of equipment were strung out


ROBOT'S MAGNETIC PICKUP POINT
PICKUP POSITION FOR STYLE SELECTED
ROBOT MECHANISM
INDEX TABLE FOR FOUR BODY STYLES
CHASSIS AND WHEEL ASSEMBLY LOADING RAMP
LOADING STATION
TO OFF-LOADING BINS FOR ASSEMBLED CARS
ALIGNMENT STATION
ASSEMBLY STATION
WELDING STATION
INSERTION STATION
OFF-LOADING STATION

Future factory. General Motors demonstrated an open system manufacturing scheme, including a miniature robot assembly station, at the National Computer Conference.

mises equipment have seen the most pronounced import growth, he disputes the assertion that the same pattern is absent from other industry segments. In 1984, sales of network equipment by foreign firms will hit \$1.5 billion—a 30% increase over 1983, with the potential to triple over the next five years, he told the committee. "Thus, our projections are that the experience with CPE [customer premises equipment] will be repeated in other telecommunications product areas. What we have seen is only the beginning."

Particularly alarming to the EIA and AT&T is the equipment sourcing strategy shared by the regional Bell operating companies. Eager to prove that they've severed ties with AT&T, the seven companies have gone after foreign suppliers with a vengeance, McDonnell says. Each is now marketing three lines of private branch exchanges and, with the exception of Bell South, at least one of those systems is foreign-made. Ameritech in the Midwest signed all three contracts with foreign vendors.

TABLE 1: TELECOMMUNICATIONS MARKET, 1983–88
(PERCENTAGES OF GROWTH)

	All equipment	Transmission equipment	Switching equipment	Equipment on customer premises	Cable, wire, fiber optics
Total U.S. shipments	7.8	8.0	6.8	7.4	7.3
Exports	6.6	7.7	7.2	4.6	9.1
Imports	10.1	9.6	15.2	10.1	11.3
Domestic consumption	8.2	8.2	6.1	8.8	7.2

SOURCE: INTERNATIONAL TRADE COMMISSION

Shut out. What these agreements do is close a major share of the market to U. S. firms, already slightly behind in the race to deliver new products. "Once RBOCs [the regional companies] invest in training sales, service and installation forces, they are not likely to switch suppliers," contends McDonnell.

Moreover, regional company distributorships could enable foreign firms—especially Japanese ones—to overcome their weakness in software, believes Kevin Sara, an analyst with Northern Business Information Inc., N.Y. In response to the teaming of PBX and computer makers, such as Intecom Inc. with Wang Laboratories Inc. and Digital Equipment Corp. with Northern Telecom Inc., regional companies are developing software to turn foreign-made PBXs into office automation controllers. For instance, Sonecor Systems, the New Haven, Conn., deregulated equipment subsidiary of Southern New England Telephone, has designed proprietary software enhancements for Nippon Electric Co.'s 2400 PBX, now sold as the system 2001. It plans to do the same for PBXs from Canada's Mitel Corp. "It is this kind of cooperation that will be critical for Japan in its drive to become a true supplier of integrated office systems," Sara notes.

Though the EIA and others posture as if foreign forces, led by the Japanese, have already won the battle, this conclusion may be slightly premature. A brief survey of industry activity shows U.S. firms gearing up to fight for new market share with the same aggressiveness and optimism of their foreign rivals. Their main weapon: technology.

"The Japanese operate under hair-trigger profit margins that U.S. firms simply can't compete with. Thus the more commodity-oriented a product is, i. e. key systems, the better they do. Conversely, the more technology-dependent a market is, the less vulnerable it is to Japanese penetration," says George Dellinger, a telecommunications analyst with Paine Webber, Houston.

Hence, Japanese suppliers pose little threat to the \$4 billion U.S. market for central office digital switches, whereas European companies LM Ericsson and CIT-Alcatel do. Still the ratio of imports to consumption will remain low, rising from 1.3% to 2.0% in 1993 when the market will total \$7.0 billion, reports the International Trade Commission.

U.S. producers also plan to leverage technology advantages in the competition for PBX market share. CXC Corp., Irvine, Calif., is a newcomer with a fourth-generation architecture "at least two years ahead of any product on the foreign scene," claims its vice president of strategic planning, Robert C. Hawk. The system, which is called the Rose, integrates a PBX and a local network using both baseband and broadband technologies. Its extensive functionality comes from proprietary voice and data message-processing software. With shipments starting this summer and distributors signed up, the firm expects to be filling orders in the 100s for the remainder of the year.

Another newcomer. Ztel Inc., Wilmington, Mass., is another new PBX player coming on strong. Having commenced shipments last spring of its Private Network Exchange, a PBX offering local-net functions in a token-ring design, the firm reports a two-year backlog totaling over \$100 million. By 1988, it expects to have captured at least 8% of the available market.

These companies, marginal now, will contribute to expanding the U.S. foothold in its own backyard, projects the Yankee Group, the Boston, Mass., research outfit. Last year, U.S. PBX manufacturers commanded 63.8% of the installed-line base. Four years from now, they will have 70%—albeit at the expense of AT&T, whose share will drop from 52.4% to 36.5%.

Moreover, an increasing number of overseas telecom firms are setting up outposts in the U.S. "Overall, we see import levels declining as this trend picks up speed," asserts Edwin

TABLE 2: TELECOMMUNICATIONS MARKET, 1989–93
(PERCENTAGES OF GROWTH)

	All equipment	Transmission equipment	Switching equipment	Equipment on customer premises	Cable, wire, fiber-optics
Total U.S. shipments	8.1	8.6	7.2	7.6	6.7
Exports	6.0	7.6	5.6	5.9	5.4
Imports	11.0	12.2	17.2	10.5	11.0
Domestic consumption	8.6	8.9	7.6	9.0	7.0

SOURCE: INTERNATIONAL TRADE COMMISSION

IEEE-488

At 4 ppm uncertainty, dV calibration compromises are over!

Now you can perform direct voltage calibration with greater confidence than ever before. As the world's most accurate direct voltage calibrator, the new Fluke 5440A sets new standards for uncompromising performance. It delivers outputs of 100 nV to 1100 V with uncertainties of 4 ppm, relative to national standards. No other calibrator has less uncertainty or better short-term stability (< 1 ppm)! Its full autoranging capability provides resolution sufficient for calibrating 7½ digit voltmeters.

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5440A Specifications Summary

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100 nV to 1100 V	4 ppm	4.5 ppm	1 ppm	15°C to 30°C	25 mA	0.1 ppm	Standard

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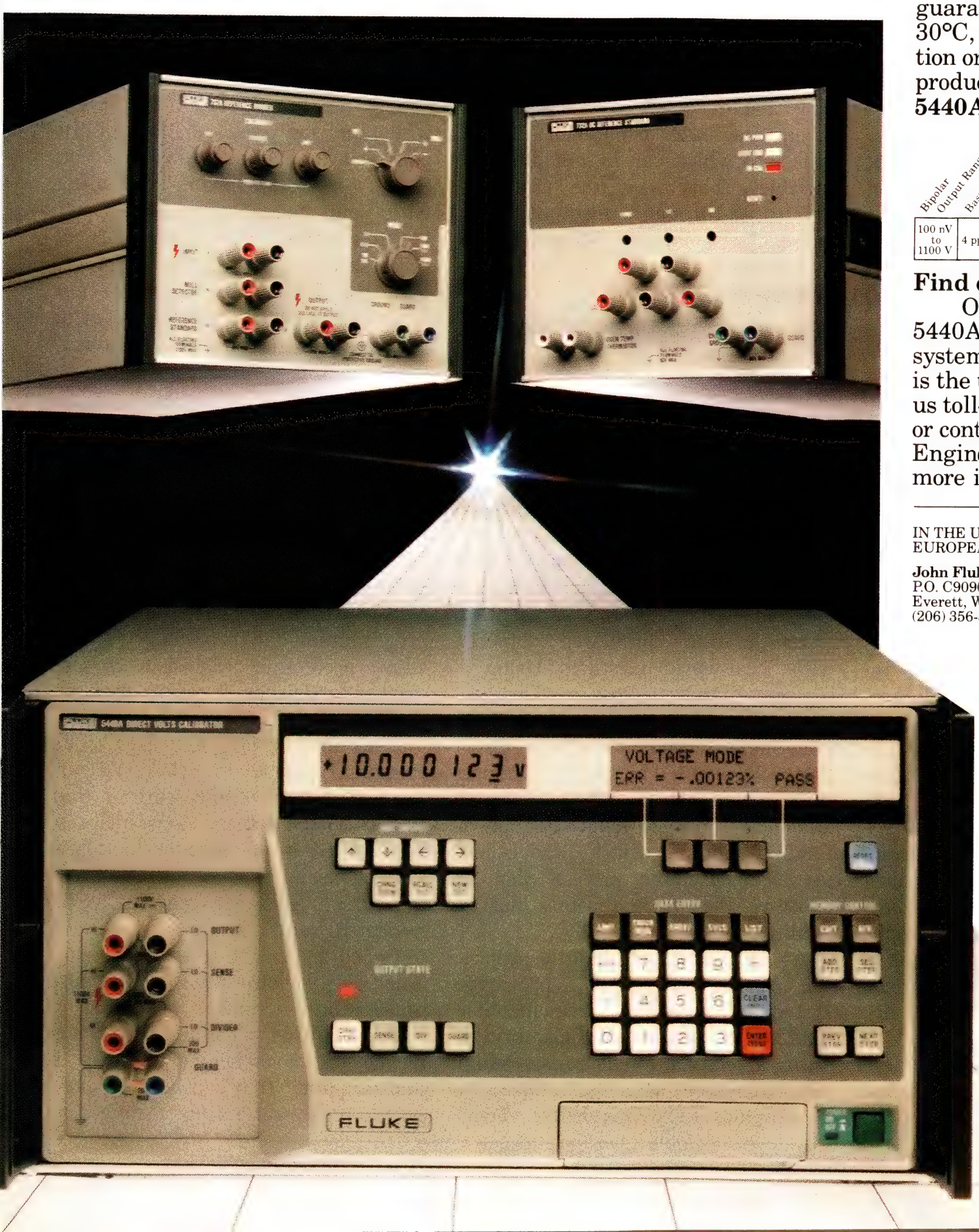

5440A Direct Voltage Calibration System.

For technical information, circle no: 49

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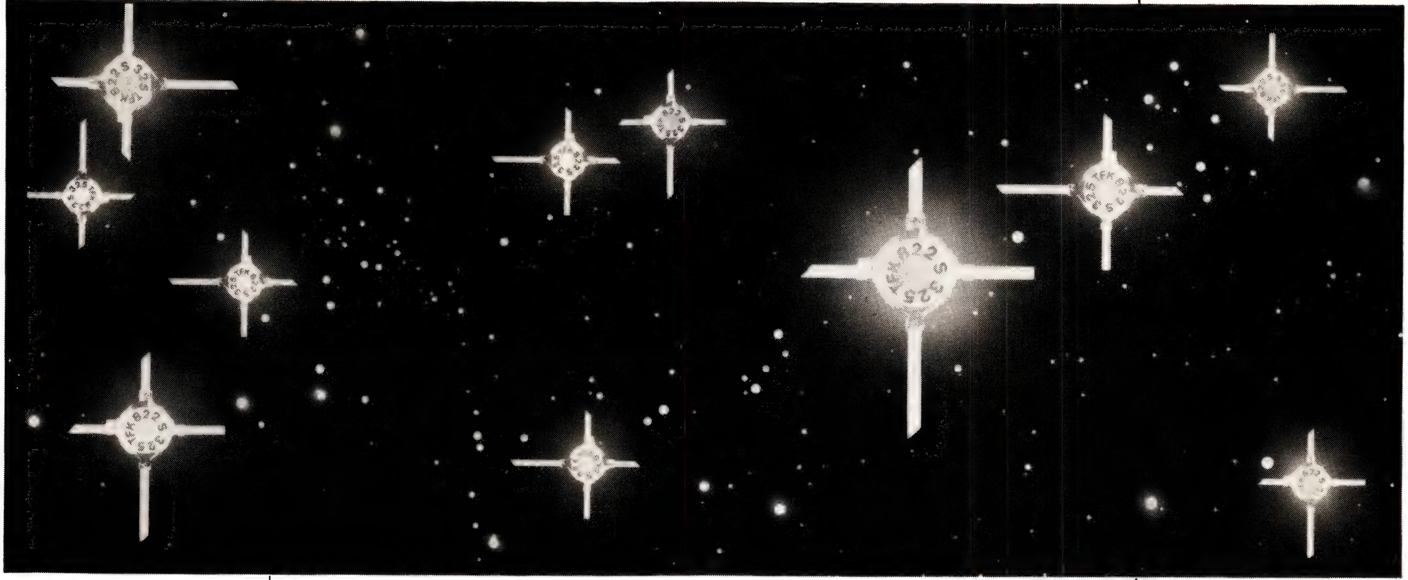
The stars of TELEFUNKEN: The fastest prescalers



TELEFUNKEN electronic produces the actually fastest prescalers – the U 822 BS and U 824 BS. These components are mainly used in TV satellite receiving systems and radio equipments. Their features: Few external components, good uncoupling between input and output, simple complement to a full prescaler system by combination of an ÷ 64 or ÷ 256 prescaler.

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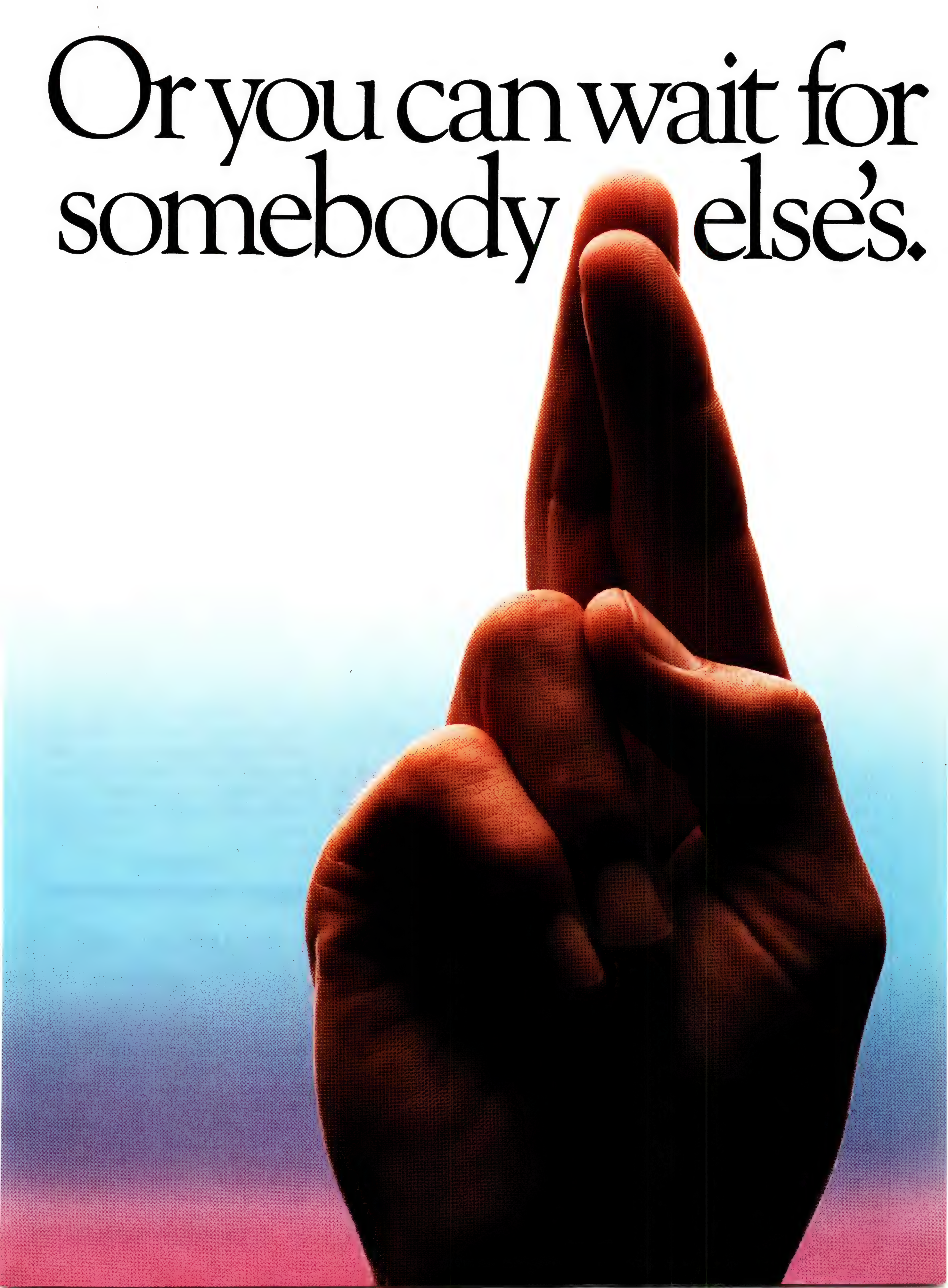
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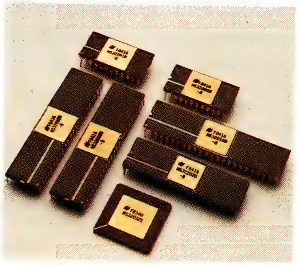

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IEEE-488

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D 2210	20 nA–200 mA	200 mV– 600 V	2 kΩ–2 MΩ
	2 mA–200 mA	200 mV– 600 V	
D 2230	20 nA–200 mA	200 mV– 600 V	2 kΩ–2 MΩ
	2 mA–200 mA	200 mV– 600 V	
D 3210	200 µA–20 A	200 mV–2000 V	200 Ω–20 MΩ
	200 µA–20 A	200 mV–2000 V	
D 3230 RMS	200 µA–20 A	200 mV–2000 V	200 Ω–20 MΩ
	200 µA–20 A	200 mV–2000 V	
DA 3232	200 µA–20 A	200 mV–(2000 V)	200 Ω–20 MΩ
	200 µA–20 A	200 mV–(2000 V)	
D 4025	250 µA–2,5 A	250 mV–1000 V	25 Ω–25 MΩ
	250 µA–2,5 A	250 mV–1000 V	
D 4045 IEC 625	250 µA–2,5 A	250 mV–1000 V	25 Ω–25 MΩ
	250 µA–2,5 A	250 mV–1000 V	

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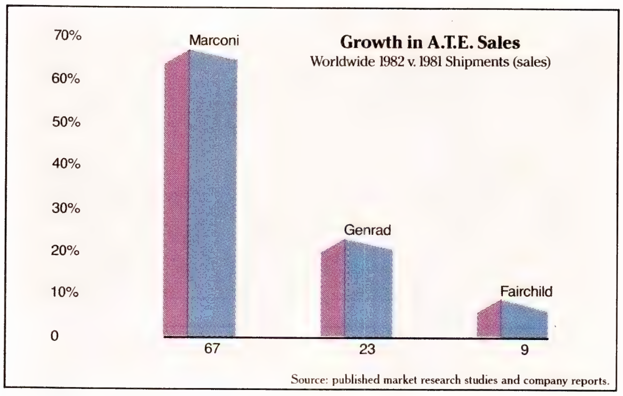

Source: published market research studies and company reports.

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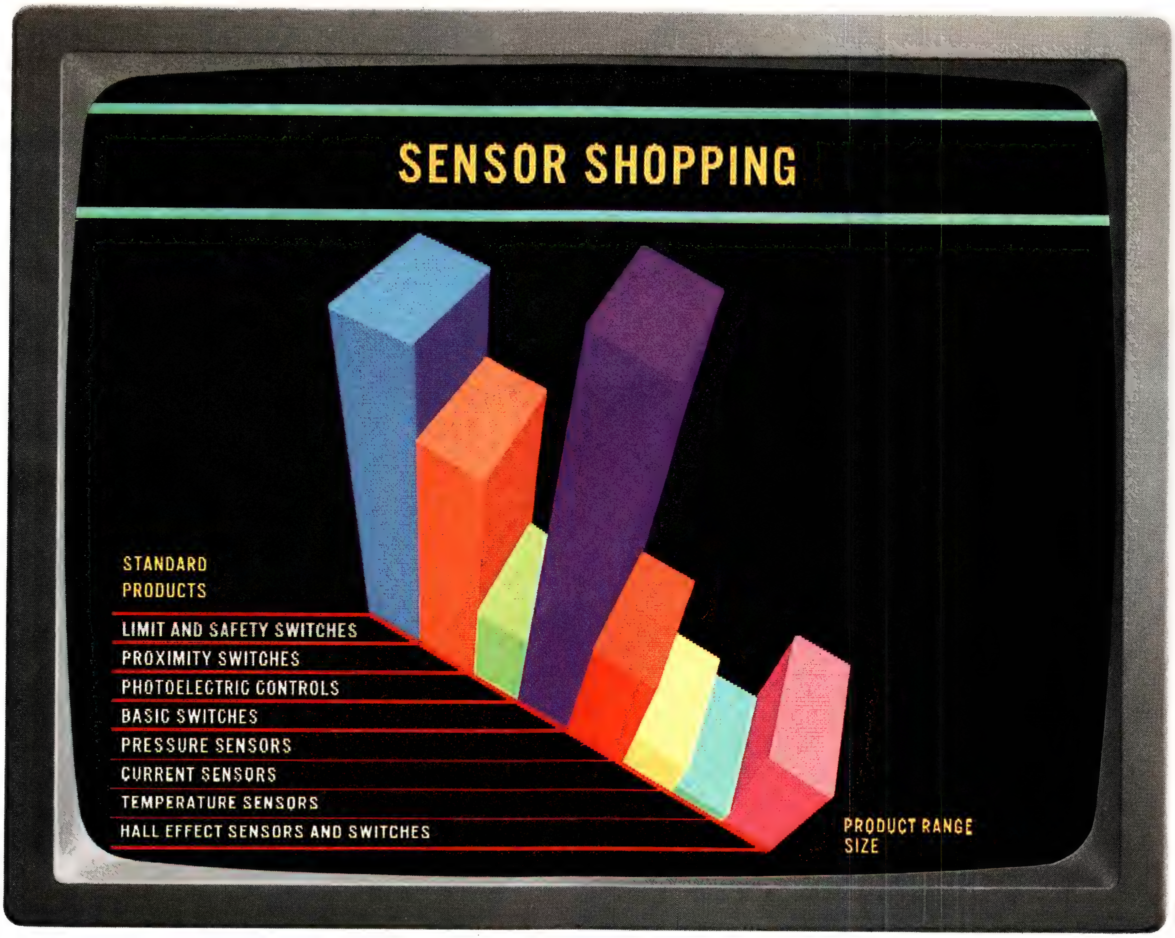

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TECHNOLOGY

TOMORROW'S ICs WILL LEARN BY DOING, SAYS TI'S RAO

Dallas

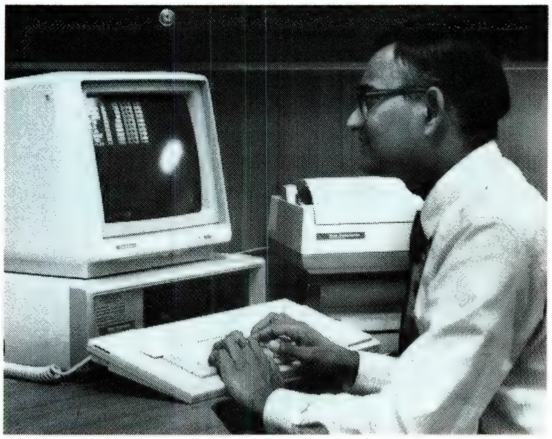
Increasing the amount of interface logic on memory chips may make them smarter, but tomorrow's high-density storage components may also be equipped with a form of knowledge-based systems that use artificial intelligence methodology. So speculates Gollapudi R. Mohan Rao, the 39-year-old manager of advanced semiconductor development at Texas Instruments Inc.

Integrating "primitive knowledge engineering" on the die, says Rao, would result in memories that learn as systems operate. "Can random-access memory do more than data storage?" asks the native of Anakapally, India, rhetorically. It is his challenge to face, since he is responsible for TI's future product directions, one major research goal of which is in the AI field.

"We always think of central processing units accessing memory—usually with one CPU. But what if we flip it and have 1,000 central processors accessing memory? Each would be processing the information differently. What you would have is a beautiful situation where the memory looks like it is remembering its associated properties" as required by each CPU. The expertise of an engineer who knows the system would be placed in the chip. The chip would understand the CPU the way the engineer would. "This is called knowledge engineering," says Rao.

Rao joined TI in June 1972 after receiving a Ph.D. in electrical engineering from Southern Methodist University, in Dallas. He also has a doctorate in physics from Andhra University in Waltair, India. Earlier this year, he was promoted to senior vice president in TI's Dallas Semiconductor Group. In addition to bridging the gap between TI's Central Research Laboratory in Dallas and the firm's semiconductor product operations, Rao sees himself as a motivator of both designers and processing engineers.

The challenge is drawing the line between the state of the art and pragmatic concerns. "These product decisions have a tremendous impact on what we do. You cannot afford to make the wrong decision," says Rao, who holds over 20 patents for his technical design work at TI.



Memory question. "Can RAM do more than data storage?" Gollapudi R. Mohan Rao is seeking the answer.

Rao says that major thrusts in advanced development at TI now include complementary-MOS integrated circuits with features below 2 μm; new design-automation methodologies for very large-scale and ultra large-scale integration; and a new generation of single-chip 8-bit microcomputers with on-board electrically erasable programmable read-only memory.

To launch the EE-PROM-based 8-bit microcomputers, TI has targeted automotive applications, which Rao says offer the challenges of harsh conditions, meaning a need for high reliability, and high-level integration for monolithic components. TI's EE-PROM will be based on a tunneling process but will be different from other technologies now on the market, promises Rao.

He declines to discuss the timing of product introductions, but says that his firm is working with a major U.S. auto maker to install the new 8-bit microcomputer in its vehicles soon. On-board EE-PROM would allow microcomputers to reconfigure their own software as well as retain data whenever power is shut off. ☐

Willder blends entrepreneurship, venture capital for STC's successful corporate recipe

London

Conservative big-company attitudes do not usually combine with the entrepreneurial spirit, but 40-year-old Simon Willder is mixing just such a cocktail at STC Technology Ltd., the new high-tech subsidiary of Standard Telephones and Cables plc. He is looking for the blend to add fizz to growth prospects and profits over the next few years.

Willder joined the parent company five months ago as it was undergoing a major overhaul. He then became head of the new company, formed from four former STC operations: Standard Telecommunication Laboratories; STC IDEC, a telecommunications development and software systems house; STC's Automation Unit; and its New Product Development Unit. STC Technology develops and markets technology inside and outside the STC Group.

"What attracted me to the job was the inspiration behind the concept," says Willder, formerly with STC rival Plessey Co. plc. "[Chair-

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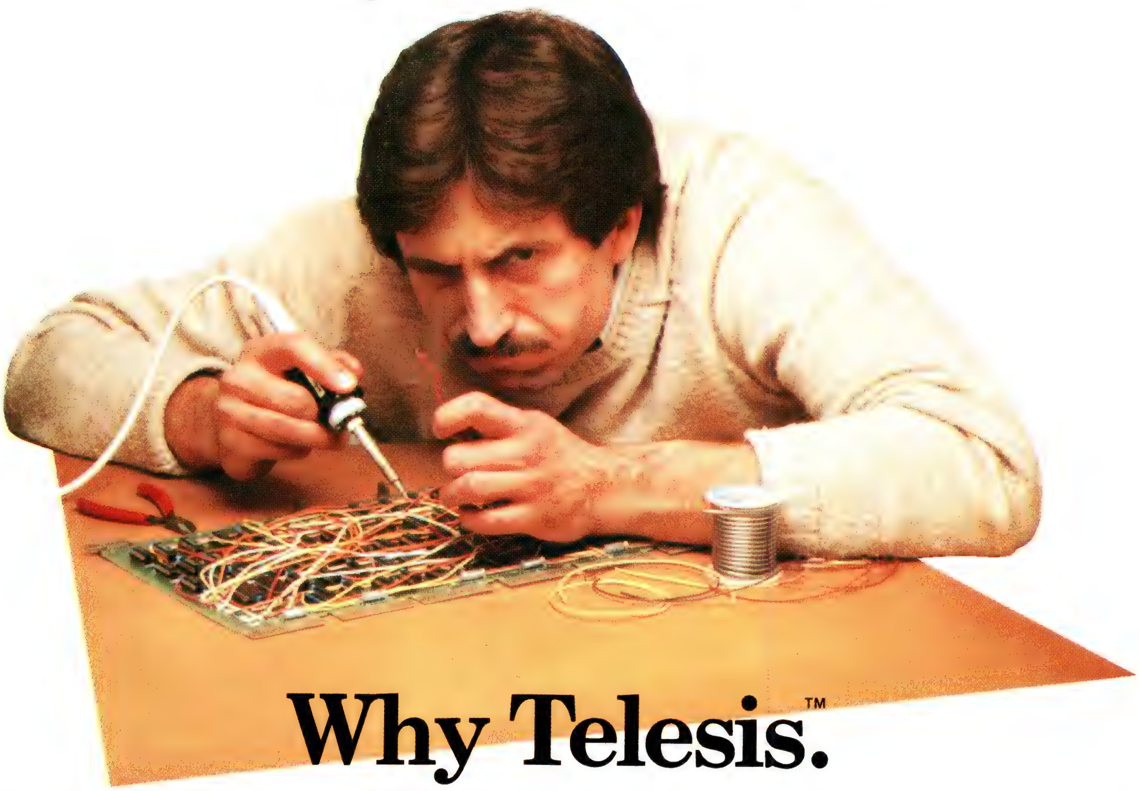

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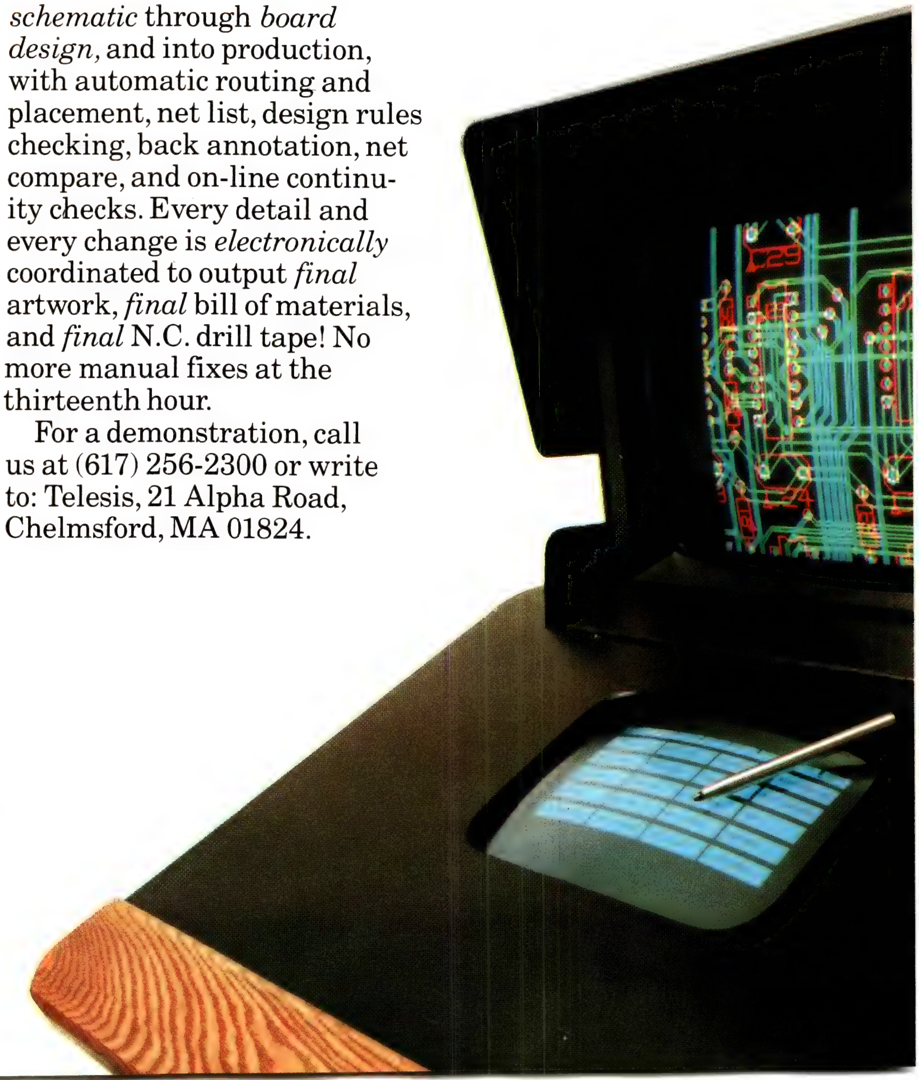

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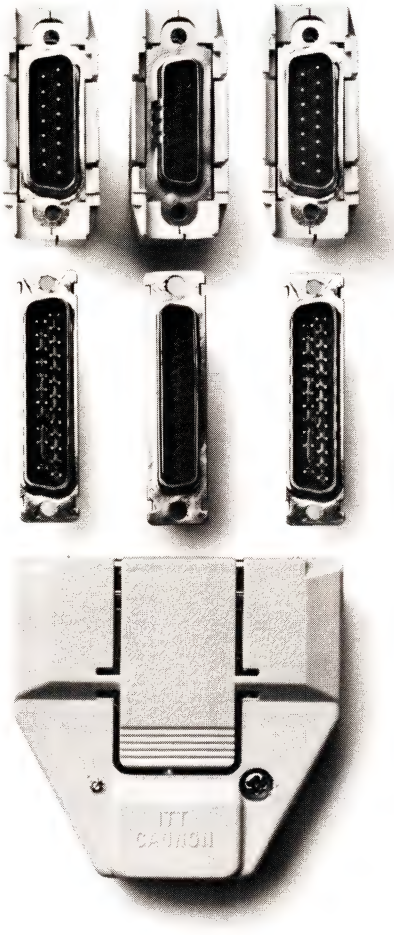

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The Global Connection

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CATERPILLAR TO BUTTERFLY, MOSTEK METAMORPHOSES WITH INDUSTRY

Carrollton, Texas

Fifteen-year-old Mostek Corp. and metal-oxide semiconductors have a lot more in common than just the letters MOS. Both have undergone the same dramatic metamorphosis since the 1970s, according to the last three original Mostek engineers still working at the firm.

Early in that decade, MOS and Mostek were both almost totally driven by semiconductor process and circuit design innovations. The two grew up together, starting mainly in the custom component arena but eventually ending the 1970s as the dominant source of commodity memory products.

At the decade's end, Mostek and MOS both found new masters: United Technologies Corp., of Hartford, Conn., bought the chip maker for $345 million in 1979, and Japanese electronics firms took much of the world memory market.

"The entrance of the Japanese into the MOS market has altered the cost of memories and changed the ability of companies to quickly get a reasonable return on investments. That's probably forever," says Robert B. Palmer, Mostek's executive vice president, who in the summer of 1969 was one of a dozen employees starting work for the new venture, which began to grow—but not without its difficult times.

When Mostek was still vulnerable to sudden changes, Viatron, its largest customer—accounting for 80% of its business—went bankrupt. All circuits sold to the terminal maker were custom, and Mostek's losses were nearly fatal, Palmer remembers. "We decided at that time that being in the custom business was not good for Mostek, and we'd leave that for others." In addition, the 1974 downturn occurred, and Mostek unwisely entered the watch and calculator markets.

The company recovered, although in the early 1980s after losing millions of dollars in depressed markets, it found it had to change along with the evolving international business. "As the industry has matured, it has become more difficult to build or maintain a company solely on technical innovations," Palmer notes.

"Mostek had some early technical innovations that allowed us to compete adequately against much better capitalized companies. But we were going through a period when cost of capital and the importance of automation were so great. If you are not able to take advantage of automation because of your limited pocketbook, it will be very difficult to increase yields, decrease costs, and compete," concludes Palmer, who now manages the recently formed Semiconductor Operation and heads a major thrust to move away from heavy reliance on memory sales and diversify the firm's product mix [*Electronics,* May 17, p. 14].

Without the financial backing of United Technologies, he adds, the company would find it nearly impossible to compete on equal footing with offshore competition. Mostek now employs over 9,000 people, compared with 60 at the end of 1969, and occupies about 2 million square ft of space throughout the world.

Today's emphasis on manufacturability of MOS is underlined by Mostek's plans to break ground this fall on a totally automated wafer-processing front-end facility here. When operational in 1987, the plant will be equipped with robots and automatically guided vehicles for materials handling. Virtually no human intervention will be necessary, maintains Marlin Shopbell, manager of manufacturing technology and the company's fourth employee when he joined in June 1969. The automated front end will carry the company into the realm of 1-megabit dynamic random-access memories, 32-bit microprocessors, and chip geometries below 1.5 mm.

Formed in 1969, Mostek was started with about $30,000—primarily raised by L.J. Sevin, who a dozen years later left the firm after United Technologies Corp.'s purchase. Sprague Electric Co. entered the venture with a $1.2 million investment later in 1969. The cost of Mostek's start-up fabrication line was around $500,000. Today, a similar attempt to meet the industry's state-of-the-art production with a small start-up fab would cost 100 times that, estimates Shopbell.

"In the early days, Mostek was engineering-driven. The issue was: what can you design and build—even a few of them," he recalls.

Onward and outward. Mostek was formed in 1969 by L.J. Sevin, who left after the UTC takeover.

"Today's market has really matured into a manufacturing-driven society. I don't care how technologically advanced a product is—if you cannot build it and make money, you won't start. That's become an important criteria in our design process."

Design and processing innovations shot Mostek into the MOS

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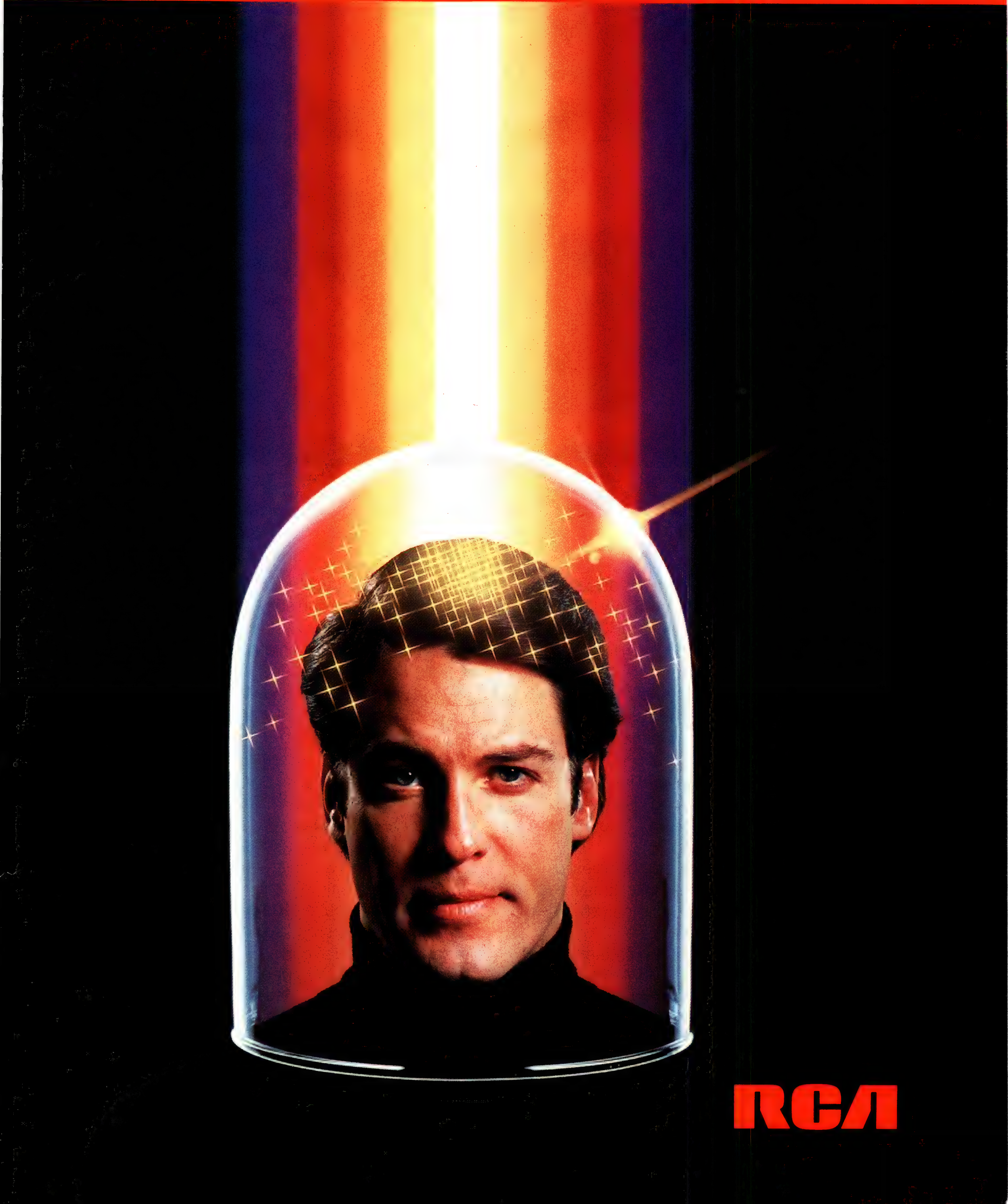

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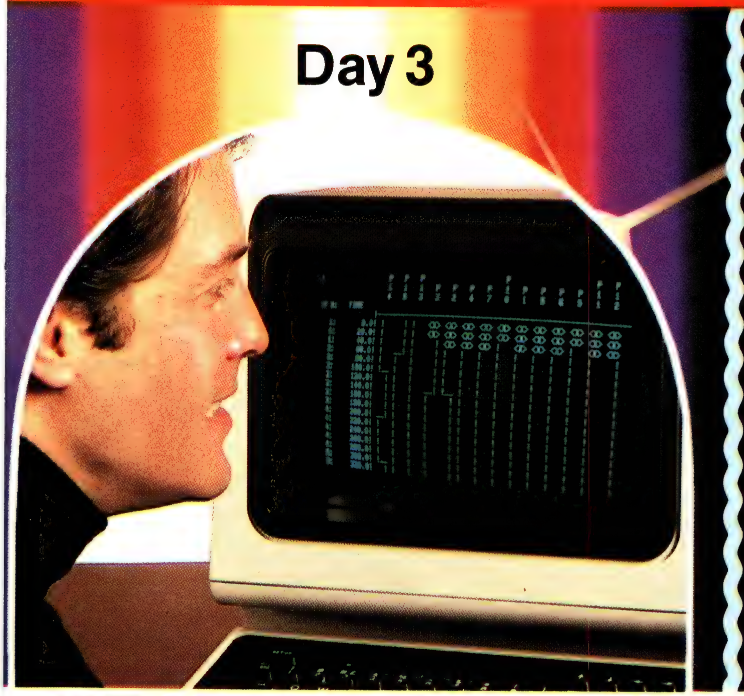

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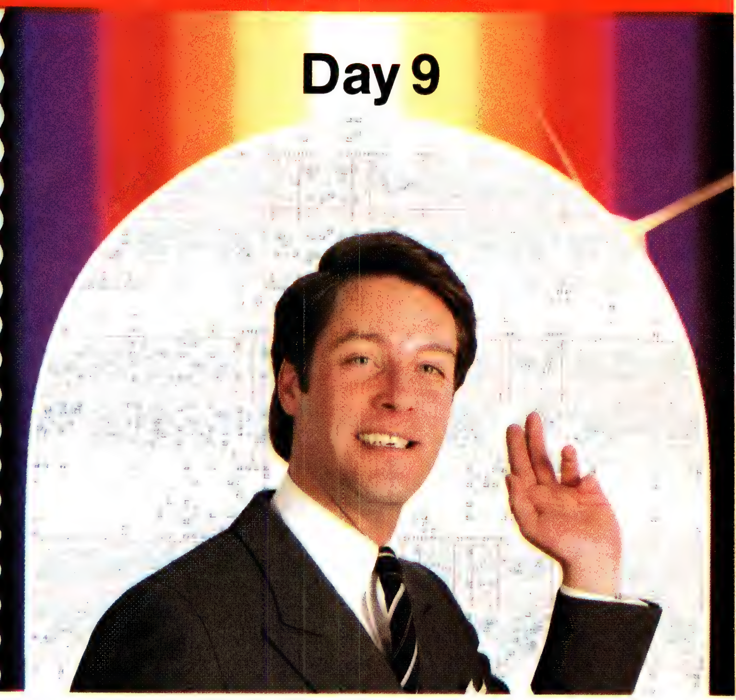

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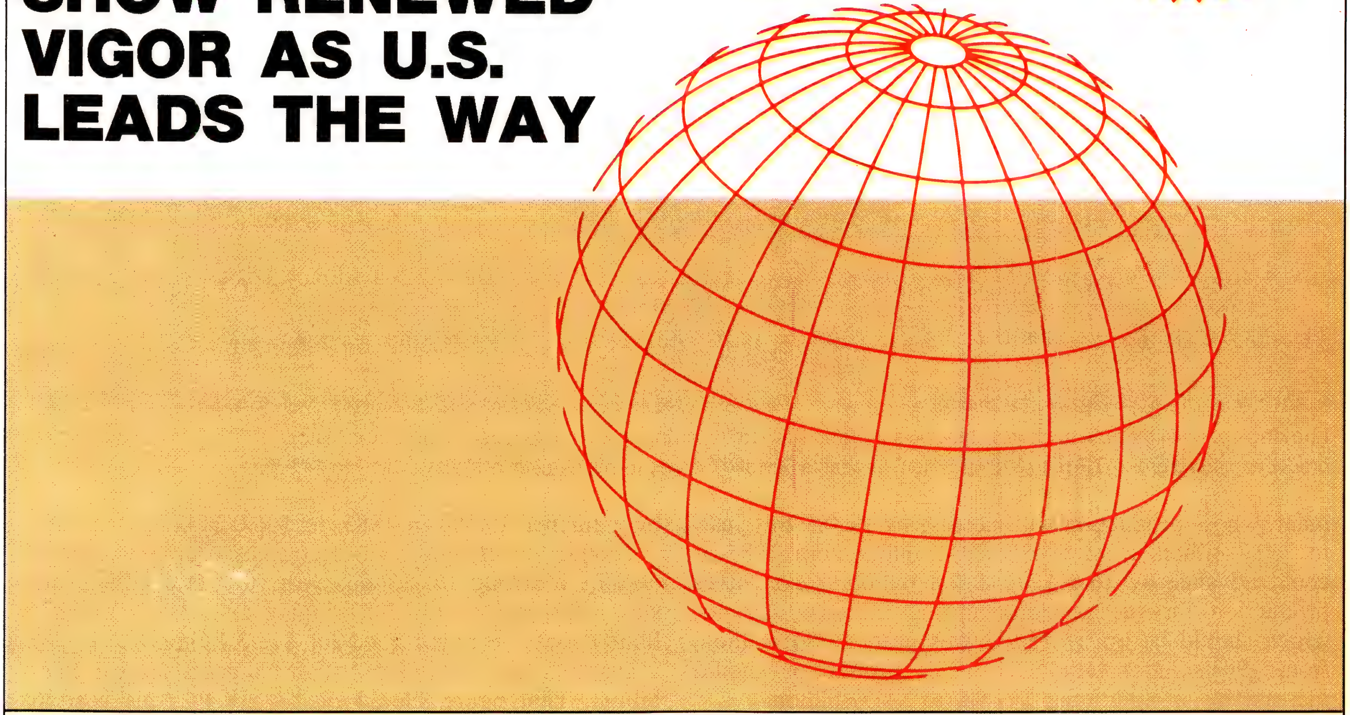
SPECIAL REPORTS

WORLD MARKETS SHOW RENEWED VIGOR AS U.S. LEADS THE WAY



Midway through 1984, the message is clear: the U.S. electronics market is having its best year in a decade. As the U.S. market booms, those of Western Europe and Japan have been dragged along in its wake; they, too, enjoy strong growth.

In a recent forecast of U.S. equipment production, Gnostic Concepts Inc., a San Mateo, Calif., market research firm, estimates that growth will hit 17.6% this year, bringing total production to $187.2 billion, from last year's $159.2 billion (see top chart, p. 86). "So far for 1984, equipment production will be the highest in over 10 years," notes Kent Webb, an economist at Gnostic Concepts. The electronics market has been "outpacing growth in the gross national product by about two times recently," he says.

One reason for the good times is clear: capital spending. The McGraw-Hill Economics Department says its 37th annual spring survey of projected new plant and equipment shows U.S. capital spending will skyrocket by 18.6% this year, to $359 billion, up from 1983's $302 billion (see bottom chart, p. 86). If that happens, 1984 would be one of the best growth years on record for capital spending.

McGraw-Hill's survey indicates that strong capital spending will continue in 1985 and future years, but at slower rates of growth. In 1985, it will advance by 6% over 1984, but in 1986 the level of increase will slow to 1%, reflecting an expected slowdown in the economy.

Gnostic Concepts also anticipates slower growth. "We see the economy slowing in the third and fourth quarters of this year," Webb notes, with flat growth by the second quarter of 1985. "We're not forecasting recession but some slow growth in the second quarter."

A welcome respite

The slackening may be a welcome respite for electronics equipment companies that have been producing flat out to meet customer demands. "People have bought a phenomenal amount of equipment," observes Joe Lassiter, vice president of Teradyne Inc., the Boston-based supplier of automated test equipment. "There's a lot of indigestion" that must be calmed, he believes. Other industry executives think a slowdown—a decline in the rates of growth, not a drop in business—would not necessarily damage the industry and might even help it.

For the moment, however, the electronics industry is still booming, and Gnostic Concepts finds that no category is booming quite so explosively as computer equip-

Data processing continues its strong growth, while IBM's domination of the industry increases

As goes IBM Corp., so goes the industry: no one company holds sway over as many segments of the information processing arena as the Armonk, N.Y., firm. Whether it's through purchasing orders imposed on the legion of original-equipment manufacturers lined up to secure IBM's business or moves on the part of the computer colossus to enter—or shun—a specific market, the decisions made by this company pave the way for the rise and fall of other manufacturers.

In mainframe computers and peripherals, IBM dominates the market to such an extent that the other large-computer U.S. manufacturers (known as the Bunch—for Burroughs Corp., what used to be called the Univac division of Sperry Corp., NCR Corp., Control Data Corp., and Honeywell Inc.) have seen their fortunes dwindle. Though business activity is currently strong, for the Bunch it comes from current customers and not from new business, or from newly entered niche markets such as microcomputers or factory automation.

To some extent, IBM has forged a new corporate entity that makes it immune to general economic conditions. Its software sales are higher than ever before, as are its service revenues. In addition, its new strategy in mainframes is to offer upgrades to existing products, so that instead of removing boxes from a customer site, the company merely adds on a new processor. Thus IBM manages to smooth out any cyclicality in its business.

But other companies rise and fall with changes in the general economy, which right now means that their performances are riding the crest (see table). "We're in the middle of the [upward] economic cycle for the computer industry," maintains Sanford J. Garrett, a research analyst with Paine Webber Mitchell Hutchins Inc., New York. The industry loosely follows U.S. corporate capital-spending levels, although the computer business trails the general economy by about 12 months, he says. As a result, companies in the computer arena are seeing "just the beginning of a strong growth period," he says. "They won't see a slowdown until 1985 or 1986," when the economy as a whole has entered a downturn.

Capital-spending booms are nothing new, but the computer industry has never seen one like this, claims William G. Moore Jr., president of Recognition Equipment Inc., Irving, Texas. Less money is going to purchase buildings and land, and much more is earmarked for productivity-enhancing computer systems, he says.

Spurring the boom—which Moore believes is about midway through its two- to three-year cycle—is the deregulation of a number of industries, such as telecommunications, trucking, airlines, and financial markets. Deregulation has emphasized the need for productivity as firms seek to become more competitive, he maintains.

"Also, most business leaders are cautious relative to what 1985 is going to bring, and they are honing productivity after they have skinnied down middle management and direct labor forces in the last recession," he says. Recognition Equipment, which is enjoying a surge in sales of data-entry systems, provides methods of capturing data in a computer, either by a new distributed key-entry system or by optical scanning.

Emphasis on productivity

It is this increased concern with improving productivity that is driving what is certainly the most volatile and fastest-growing segment of the computer industry—and the one in which IBM has perhaps caused the biggest waves—the personal computer business (see chart, p. 88). Since its introduction in 1981, the IBM Personal Computer has raced to the forefront in the microcomputer marketplace and emerged as the standard product against which all others are measured. And in doing so, it has helped its maker's bottom line. Prudential-Bache Securities Inc., a brokerage firm in New York, estimates that revenues from IBM's PC and related businesses will total $6.4 billion in 1984, accounting for 14% of IBM's total projected revenues of $46.9 billion. Apple Computer Inc., Cupertino, Calif., the No. 2 personal computer

TABLE: ACTUAL AND ESTIMATED U.S. COMPUTER SYSTEM SHIPMENTS
(MILLIONS OF DOLLARS)

Category	1983	1984	1985
Personal computer systems (Single-user systems, price range: $50,000–$20,000)	8,352	12,206	16,435
Small-scale computer systems (Multiuser systems such as IBM Series 1; DEC PDP 11/05–11/44; HP 250/300/1000)	4,460	5,320	6,310
Medium-scale computer systems (Multiuser systems such as IBM 4300, System/36, and /38; DEC VAX; HP 3000; and DG Eclipse)	7,430	8,420	10,700
Large-scale computer systems (High-end general-purpose computers such as IBM 303X, 308X, and 370 architecture systems)	8,380	7,790	8,430

SOURCE: INTERNATIONAL DATA CORP.

with the growing importance of personal computers.

The near-term challenge is to develop new methods of sensing changes and needs in various personal computer markets. In minicomputer markets, value-added resellers and system integrators were often closely tied to specific vertical markets, providing feedback for next-generation equipment or revisions. One possibility for microcomputer vendors is to team up with a new breed of value-added reseller: third-party software houses concentrating on specific applications. "Many software value-added resellers are taking the form of 'store fronts' and becoming more like retailers for vertical markets," Ellis states, adding that general retailers are also feeling pressures to differentiate themselves from each other.

Pervasive computer. IBM's PC is king of the personal computers. The firm's 1984 revenues from personal computer operations could hit $6.4 billion, estimates Prudential-Bache Securities Inc.

Price versus performance

HP expects the boom in business to continue throughout the next 12 months. One reason for this is that the lag of the European economic recovery compared with that in the U.S., which was still much in evidence a year ago, has largely disappeared—and European business is sustaining the good times.

The Palo Alto, Calif., firm which trails IBM and Apple in the desktop and portable computer markets, has a long way to go in becoming a dominant force in the field, but Paul Ely, executive vice president and general manager of the Computer Group, foresees a continued strong economy and good market opportunity for the business. With the computer division's growth currently running at about 32% above a year ago, both domestically and internationally, there seems small reason for concern in the near term. Says Ely, "Hewlett-Packard inched its way into third place, and we're delighted to be there. Our goal is to solidify our position."

Looking at the whole market, he says "there is much less attention today to the under $200 computer, but a lot of the attention is for computers in the $1,000 to $6,000 range." HP faces new competition in that niche from AT&T and from Apple's newest products, which Ely dryly describes as "not toys." He does not know what effect portables will have in the market; his company's entry, The Portable [*Electronics*, May 17, p. 42], is just beginning to have an impact.

As for the low end of the personal computer segment—the home market—John V. Roach, chairman and president of Tandy Corp., Fort Worth, Texas, maintains that it remains an excellent market despite highly publicized failures in this arena. "I think the thing you have to look at is what is the market for computers priced over $1,000 in the home?" he says. "The broad-base consumer buyer in America simply cannot afford a relatively high-priced machine that has some limited utilities as well."

Roach estimates that Tandy's Radio Shack stores are now selling three times the number of its Color Computer as a year ago. At that time, the industry was caught in a price war between products made by TI, Commodore, and Timex. "That caused a lot of confusion in the marketplace," he says. With many consumers becoming more familiar with computers, "interest has shifted somewhat toward systems with more power and memory, larger disk capabilities, and better printers."

He thinks the 8-bit business computer—Tandy's TRS-80 Model 4 and the Apple II models, for example—sell well because of the large software base and because they can do most applications just as well as the low-end 16-bit personal computers. "You see these machines still selling well, but at significantly lower prices," he adds.

IBM's price cuts on its popular 8088-based PC have placed great pressures on firms selling PC compatibles, Roach says. For that reason, he believes Tandy's approach the market is more sound, since the Model 2000 is based on an Intel 80186 and runs MS-DOS software much faster. "It's a high-performance machine and can serve the software needs of the future," Roach says.

High-margin microcomputer and mainframe offerings pace growth in the ever-expanding software market

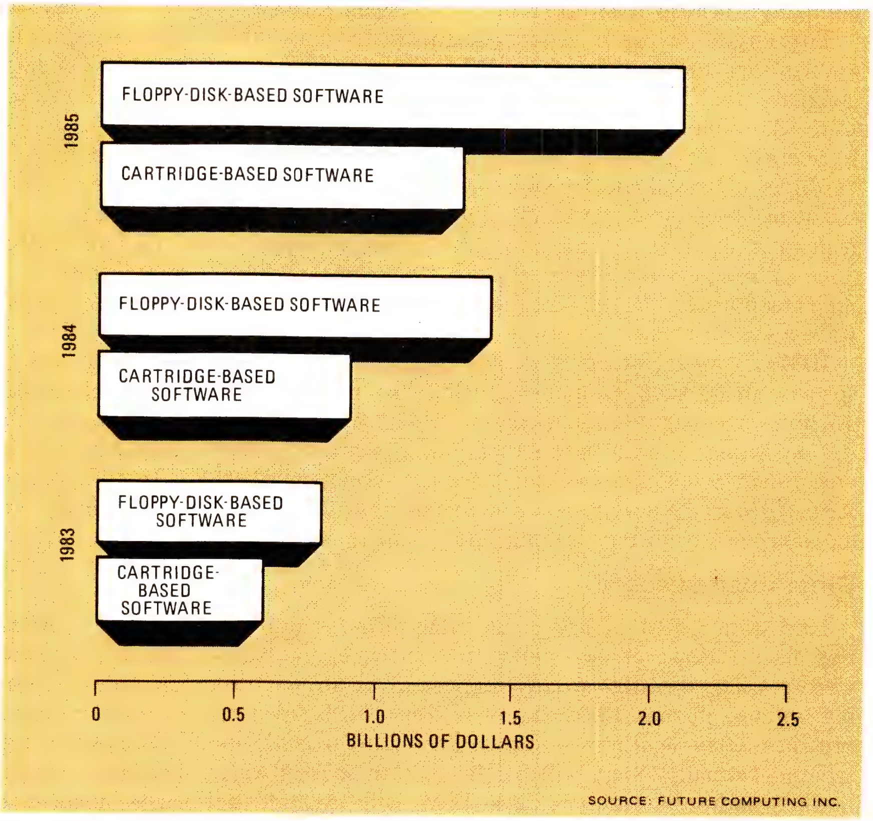
With margins for products ranging between 85% and 90% and with strong prospects for growth, the software industry—especially the microcomputer segment—is the place to be right now. The U.S. software market totaled some $9.3 billion in 1983, according to Input Inc., a Mountain View, Calif., market research firm that conducts a survey for the industry's main trade group, the Association of Data Processing Service Organizations, Arlington, Va. (see top chart, p. 90). Applications software accounts for 53%, or $4.9 billion, of the total, and systems software, the rest.

The total 1983 figure represents a gain of 39% over of 50% (see chart, right).

With growth rates like those, it's no wonder that new software companies are springing up all the time, "with visions of sugarplums in their heads," notes Brian Boyle, a market watcher for Gnostic Concepts Inc., a San Mateo, Calif., market research firm. "There is still high growth in the software business, "with no indication of it slowing," he says. As a result, the industry is "a draw to people" who want to strike it rich. Boyle points out that if 10 new firms open up in the software business, nine may strike out but the 10th may do well.

However, that higher mortality rate among software start-ups is scaring off some of the venture capital money that funded so many of today's high flyers. "It's getting harder to get funded for the start-ups," Boyle notes. "A number of investors have gotten burned [so that now] the venture capital people want a risk-free proposition with a lucrative return" before they will invest.

Potential software entrepreneurs and their investment partners will probably try to emulate the success achieved by Lotus Development Corp., the Cambridge, Mass., firm that is famous for its 1-2-3 integrated software product and its follow-up, Symphony. In 1983, its first full year of operation, Lotus earned $14.3 million on revenues of $53 million. (To illustrate the difference in margins between software and hardware, Houston-based Compaq Computer Corp. reports that it earned $4.7 million on sales of $111.2 million worth of personal computers in its first full year of operation.)



SOURCE: FUTURE COMPUTING INC.

Catching up. As the data processing needs of home computer users continue to grow in sophistication, the amount of software that is based on floppy disks will overtake that resident in cartridges, believes market research firm Future Computing Inc.

Stimulating demand

"Business is great," exclaims Jim Manzi, vice president of marketing and sales at Lotus, who attributes the firm's success both to its product line and a strong overall market. Recent price cuts by IBM on its various models of personal computers "will stimulate demand" for software offered by Lotus and its host of competitors, he observes.

Those competitors run the gamut from even younger start-ups, to relatively mature microcomputer software houses, to mainframe software vendors who want to capitalize on the market's strength. In the latter category, Cullinet Software, of Westwood, Mass., and Management Science America, through its recently acquired Peachtree Software Inc. subsidiary, are moving to penetrate the microcomputer software market. Management Science's Imlay notes that Peachtree's revenues totaled $3.3 million in its first year under his company's ownership. Last year, revenues climbed to $21 million. "We expect it to continue to grow at a rapid pace, perhaps by 75%," he says.

This hoped-for penetration of the microcomputer market will lead to "one-stop shopping" for software, notes International Data's Morley, so that large corporate users will be able to get all their software needs from one vendor. "More [software] companies are trying to be all things to all people," she says, adding that "the margins on incremental [software] sales are very attractive."

She feels that one advantage mainframe software vendors have over their microcomputer software rivals is that they are more stable companies and have better experience in managing their growth and in bringing out a steady stream of new product enhancements. Of course, not everyone agrees with that view.

"The microcomputer software market is different from the mainframe software market," observes Lotus' Manzi. "You can't just throw money at it" in an attempt to develop new products and gain market share. The big companies are "very formidable" but they have "failed to prove they can deliver," he says. "They face a long, uphill road."

Alive and well

If mainframe vendors seeking to get into the microcomputer software market face a tough time, they can rest easy with the knowledge that their basic business—mainframe software—is "still alive and well," according to Gnostic Concepts' Boyle. In fact, "the personal computer market is stimulating the mainframe market," he notes, citing such products as the famed "micro-to-mainframe-link" which allows the scores of personal computers within a large organization to be connected with the that demand is growing for a 1.544-Mb/s service for video conferences and for high-speed data connections, says Culp. But he warns that the Bell divestiture has a worrisome side, too, for economic pressures could drive different operating companies toward incompatible technologies. "We don't want to lose the quality of the network we've all come to expect," he adds.

The seven regional operating companies have set up Bell Communications Research—Bellcore, which resembles the old Communications Service Organization—to keep tabs on emerging standards and the ROCs' adherence to standards in order to maintain the integrity of the U.S. phone system. Culp, however, worries that profit pressures could undermine its efforts. He wants to see "coordination of all of this, so you don't wind up with seven completely separate operating companies, technically and financially."

Thanks to deregulation, foreign competition will also confront the U.S. telephone business in coming years. Already, Japanese and Canadian companies have strengthened themselves in the U.S., especially in the market for digital private branch exchanges—whose sales could reach $2.5 billion by 1987, according to Venture Development Corp., Wellesley, Mass. (see table). Like the rest of U.S. industry, telecom venders must improve quality and reliability if they are to compete, Culp says.

Replacement for Bell Labs

Culp is not sure if joint research consortiums can deal with the constantly higher costs of developing telecom technology, but he does believe that something will have to replace Bell Laboratories. "What we have to spend our money on are things that must pay off in five to six years, frankly, and the thing that we need to be doing is to find a way to finance efforts that pay off 10 to 15 years from now."

One new technology exploding in the telecom marketplace is fiber optics, says Culp. Higher quality and lower costs will help it grow from its present size of between $140 million and $150 million. "There is a very real likelihood that we could see a crossover in volume to lightwave versus radio-transmission products in two years or sooner," he believes. Rockwell makes fiber-optic systems and subassemblies for terminals and repeaters, as well as microwave transmission systems.

Elsewhere in the communications arena, Tymnet Inc. of San Jose, Calif., the communications service of Tymshare Inc., reports very healthy growth. Revenue on its public network, Tymnet, is up at a compound rate of 27% a year, and revenue on its 24 custom networks is expected to increase by 50% over the next 12 months. Clint DeGabrille, vice president for marketing and field operations, thinks that the marketplace will not be saturated within the next 10 years, although Tymnet already services many of the largest U.S. corporations.

Data communications activity will stay at a high level for the next year. According to DeGabrielle, the field remains "significantly impacted by the telephone company breakup. The current posture for local companies is to raise rates" both for local customers and services like Tymnet. He expects that although Tymnet's traffic volumes will rise greatly, "we will have to pass these costs on." In addition, the industry's growth will be boosted by the sheer number of personal computers equipped for telecommunications and by the growth of credit transactions as bank debit cards become a way of life.

New York recently joined the small but growing list of U.S. metropolitan areas served by cellular mobile telephones. As this kind of gear begins to take root, engineers look to other applications, like data transmission, to further the technology. Dan Chandler, the director of national service for Oki Advanced Communications, in Norcross, Ga., which makes cellular phone equipment, says that his firm has actually transmitted data to and from a communications satellite. Although confident that data transmission over cellular systems will work, Chandler cautions that "we're not sure anybody will have a use for it." Christine Davies, speaking for Bell Atlantic Mobile Systems, of Basking Ridge, N.J., says the small size of the present cellular network makes it hard to test the feasibility of data transmission.

As for the much-heralded but slowly developing videotex market, several observers say that it will apparently stay sluggish. "They're not waiting out there with bated breath for this to come along," says Bernard Mounty, editor of a consumer electronics newsletter that recently conducted a survey on consumer attitudes toward videotex. "When you go out to buy a dress," he explains, "half the fun is actually buying the dress." Videotex, however, is too new to have products to show off.

Walter F. Loeb, vice president with brokerage firm Morgan Stanley & Co., New York, says the cost of videotex remains staggering. He believes that an information-based consumer system is still some time away.

Rising demand for new and improved products triggers boom in sales of consumer electronics

Back in 1979, RCA Corp. Group Vice President Jack K. Sauter predicted that by the late 1980s, U.S. consumers would be dampening their love affair with the automobile and starting one with consumer electronics. Sauter now says that the current sales boom seems to be bearing out his prediction even sooner than he had thought.

For example, the Consumer Electronics Group of the Electronic Industries Association expects that U.S. sales of video cassette recorders will hit 7 million units this

Increased capital spending for productivity improvements proves a boon for the industrial equipment market

The climate in the industrial automation business is nothing short of excellent, according to J. Tracy O'Rourke, president and chief operating officer of Allen-Bradley Co., Milwaukee. "If you look at the breakdown of capital spending for productivity improvement versus spending for capacity and/or bricks and mortar, there's a significant skew toward the productivity spending right now," he notes.

By spending for productivity, O'Rourke means spending for equipment to reduce labor costs and improve quality (see chart). Allen-Bradley's line of intelligent components includes programmable controllers and computerized numerical controllers as well as electronic drives, sensors, and other such products.

Asked to quantify the skew, O'Rourke says, "We have some businesses that track well with what's going on in new construction in the industrial market, versus businesses that supply intelligent devices to the productivity improvement market, and growth is skewed at least 3:1 in favor of the intelligent devices." Growth among intelligent-components suppliers is running "in the 25% to 30% range, maybe more, and it has been for some time."

For the next 6 to 12 months, O'Rourke expects more of the same. "In this type of business, the momentum builds for a while, and it takes a while for it to slow down. . . . The remainder of 1984, in our opinion, looks quite solid and, since the momentum is there, we feel good about 1985—certainly at least for the first half." Even if the economic recovery dips, O'Rourke sees nothing worse than a slowing of the growth rate in the latter half of next year and in early 1986.

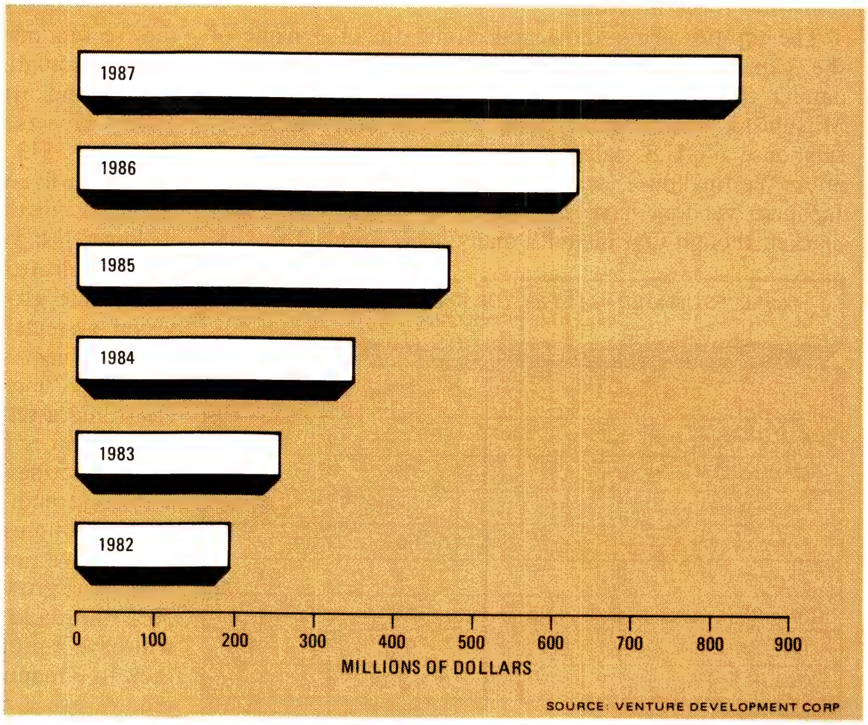
Things could go wrong for the industry, he admits. "We've all [in industry] become very interest-rate sensitive. If interest rates go crazy, we'll probably see a slight psychological hesitation. But even in the prior capital-spending recession, we didn't see anything go down in our intelligent-devices business—we just saw the rate of growth slow. People in the manufacturing world today are going to have to keep spending at some rate or they're just not going to remain competitive."

O'Rourke notes that "the push toward automation to gain productivity and higher quality is global. . . . It's a race that people can win or lose, and in the next few years, I think everybody's going to keep running the race." He does not see the coming election as having an effect on the business, at least not through 1985.

In terms of the market's major players, O'Rourke contends that Allen-Bradley has the lead among suppliers of intelligent and unintelligent machines for control on the factory floor. Gould Inc. is another major player. Over the next few years, he predicts that "there's going to be some shifting among the major players domestically, and the foreign competition is going to become more active." In terms of the foreign competition, the ones to watch in Europe include Siemens AG, General Electric Co. plc, and Sweden's Asea AB. In Japan, "there will be others, but Mitsubishi is the main player," O'Rourke observes.

Elusive profits

Despite all the players and a domestic market that will be up significantly from last year's $240 million mark, the robot business is still not profitable for most vendors, claims Laura Conigliaro, a research analyst with Prudential-Bache Securities Inc., in New York. "This year, we may see two or three, or maybe four if we're really lucky, who cross into the black," she notes. The list of



SOURCE: VENTURE DEVELOPMENT CORP

Improving output. With U.S. manufacturers boosting their capital spending for productivity-enhancing equipment, consumption of industrial robots in America will show healthy increases, reaching $828 million by 1987, estimates Venture Development Corp.

multiples of the cost of the robot itself, he says, adding that "some jobs can't be done at all with blind robots."

Among factors that could be a drag to growth, Villers cites vigorous competition and the amount of customization required for assembling systems. Despite growing customer awareness, a number of potential customers aren't yet convinced that they need the type of systems sold by Automatix and others. (Villers likens this situation to the early days of integrated circuits, when many engineers didn't see their value and still favored discretes.) Thus the customer education process is still an extremely time-consuming portion of the business.

Bullish outlook

Despite the usual summer slowdown in the factory automation business, the outlook for the rest of the year is bullish at GCA Corp.'s Industrial Systems Group, in Naperville, Ill. "We expect July, August, and September to be very big months," thanks to a pent-up demand in capital spending budgets that is about to break loose, say group vice president Dennis E. Wisnosky. For example, the automakers typically begin to ramp up spending around July as they gear up for model changeovers, for example, he says. "I wouldn't be surprised to see some delivery problems [industrywide] occuring later in the year," he notes.

At GCA, which supplies a full line of robots, controllers, networking systems, and other automation equipment, "there's no doubt that our sales this year will be at least twice that of last year, maybe more," Wisnosky says, while bookings will be up by an equal amount. The GCA group has done well in supplying the aerospace industry and is now beginning to see business increase in the electronics market sector. Since GCA is a leader in the wafer-handling industry, the Naperville group sees particular opportunities for automating semiconductor fabrication facilities, with integrated systems that tie together fabrication, assembly, and test functions.

Taking the lead. Allen-Bradley's J. Tracy O'Rourke thinks his company is No. 1 in the market for intelligent and unintelligent machines to control factory floors. He also sees the overall market remaining strong through the first half of next year.

But some clouds mar the industry horizon. Wisnosky notes that "a lot of people [factory-automation suppliers] bought into jobs earlier [and they] are now having to deliver those jobs at low or no margin." Some of these suppliers may decide that it's not worth it and drop out of the market. Some may even decide not to deliver on jobs for which they are already committed, he suspects.

GCA's Industrial Systems Group is "still in an investment mode" and is not yet profitable, Wisnosky confirms. But the group expects to move into the black during 1985.

U.S. MARKET REPORT

New product introductions hold the key to continued success and to future growth in the test equipment market

The U.S. test and measurement industry grew rapidly in the first half of 1984, following good growth throughout 1983. Executives hope the pace of business will slow somewhat so they and their customers can digest the growth comfortably. Yet they and market watchers say that despite good business conditions now, test and measurement firms must plan and implement technological change or face the prospect of losing market share during the next business cycle.

Industry-watcher Prime Data, San Jose, Calif., puts the total 1984 market for test equipment at $6.6 billion in 1984, up from $5.6 billion in 1983 (see chart). Of this total, the market for automatic test equipment hit $1.3 billion last year and could advance 33%, to $1.7 billion, this year. In all parts of the U.S. market, business is "a lot stronger" today than it was a year ago, notes Philip J. Robinson, vice president and general manager of the Instrument Systems Group of Tektronix Inc., Beaverton, Ore. Robinson says that the first signs of a pickup in orders came in March 1983 and that momentum has been building since then in the U.S. The international market has perked up in the past two to three months, although the big news is the dollar's strength, which drives up the price of U.S. products and makes them less competitive abroad.

For the fiscal year that ended on May 31, Tektronix saw its overall orders rise by 30% over last year's levels, and most of the increase came from the U.S. With a gain of 60%, information-display products accounted for the biggest improvement, while revenues for instruments, we haven't earned since we've been public."

Van Veen maintains that the test equipment market "is a consistent growth industry" for the test and measurement industry as a whole. "Since 1975, there's been no down year [for the industry]. Individual companies, though, have had their up and down years." He argues that "it's hard to see how 1984 will be anything but an outstanding year" both for Teradyne and for the industry as a whole. "As each week goes along, the chances increase for an outstanding 1985" as well, he says. "We are seeing as good an environment for growth as you'll ever see," and "if you [a test-equipment vendor] aren't doing well, something is wrong with you."

Not when, but how long

Van Veen admits his crystal ball is no clearer than anyone else's but does believe that the big concern should not be when the next recession will occur, "whether it will be in the first quarter or the second quarter [of 1985]. The real question is not when the recession will occur but how deep and how long it will be," he maintains. "If by recession, you mean a slowdown in the growth rate of companies, we're bound to have one. And it probably will be healthy for industry."

To bolster his argument, Van Veen points to Teradyne, which he describes as a company usually growing at 25% to 30% a year but now experiencing a period of 60% growth. Such periods have to be followed by a slowdown, he believes. "Will a slowdown be a 12-to-18-month period of 2% growth [for the gross national product] versus 5% to 6% growth, or is it a depression? A moderate slowdown in 1985 and 1986 is the kind of thing the industry could shrug off."

Perhaps because 1981 and 1982 were so severe, "people are conjuring up terrible thoughts of a recession," he says, although most recessions in the 1950s and 1960s were breathing spells for the country. A recession "doesn't have to mean massive layoffs," he points out. If a company manages itself prudently, it should manage without damage.

Van Veen agrees that the test industry needs a steady stream of new products to survive. "The best way to deal with a recession is to have the right products for when the customer shifts from an expansion mode to a design mode. The test-equipment company that can handle the next generation [of equipment] will do all right."

EUROPEAN MARKET REPORT

Microcomputer mania takes hold in information processing, although 1984's brilliant growth will slow in 1985

If the dominant factor in Western Europe's market for information processing equipment could be summed up in a single word, it would be "microcomputer." From the UK to France, from West Germany to Italy, microcomputers are outselling their larger cousins as personal computing takes hold in offices and homes alike. Much of the demand comes from the revival of the Continent's economies, for thus far, Western Europe's 1984 growth has been brilliant. But going into 1985, signs of a slowdown are visible, and the prospects for 1986 are murky.

Buoyed by the recession's end in most Western countries and by the resulting increase in orders at home and abroad, West Germany's electronics industry is optimistic as it enters the second half of this year. The only exception is the entertainment equipment sector, which is still sluggish. Despite the long strike that plagued much of the country's industry this spring, prospects for business have seldom been better since the late 1970s.

Data processing equipment is among West Germany's fastest-growing sectors and "would be doing even better if it weren't for the cyclical bottlenecks in the supply of semiconductor components," says the computer consultant Diebold Deutschland GmbH. "More and more jobs are opening in the terminal-to-computer dialog chain, and that is creating a demand for more computing capacity," Diebold adds.

The Frankfurt firm predicts that in the first half of 1984, orders for systems priced above $100,000 will be 10% to 20% higher than they were last year. An even faster spurt in orders—on the order of 30% or so—has hit systems in the $10,000-to-$100,000 class, says Diebold. Personal computers are by far the fastest-rising sector, though: Demand could go up by 35% to 70%, with smaller systems—primarily 8-bit machines—enjoying the biggest gains. During the second half of this year and beyond, the flood of orders should push West Germany's data processing market to new heights.

Shakeout coming

Looking beyond Germany, Intelligent Electronics Europe, a Paris-based market research firm, estimates that the installed base of professional personal computers in Europe's five major countries—France, Italy, Spain, the UK, and West Germany—reached 875,000 units by the end of last year. By the end of 1984, that figure should go up by about 60%, to nearly 1.4 million units, and it should rise by an additional 47%, to 2.05 million units, by the end of 1985. Europe's biggest consumer of personal computers is the UK, followed by West Germany, France, Italy, and Spain. A shakeout of suppliers will accompany the market upsurge. Diebold thinks that of 200 companies that today make personal computers, only 40 will be left in the game by 1987.

In the UK, all the fizz comes from the newest brews of home and business computers; the older mainframe vintage is distinctly flat. International Computers Ltd. plc, the UK's largest computer group, is a handy weathervane for the country's mainframe computer sector. In

Move to newer technologies and products spurs communications equipment market

For Western Europe's communications industry, the digital age has arrived. Government-run communications conglomerates are improving the quality of products and services throughout the Continent.

In West Germany, for example, postal authorities last year decided to use digital switches in long-haul telephone networks, and the first systems are now in place. Munich-based Siemens AG and ITT-affiliate Standard Elektrik Lorenz AG in Stuttgart—marketing EWSD and System 12, respectively—have emerged as the prime suppliers. Shipments of digital switches could reach $50 million next year, when they will first be used in short-haul networks, too. However, the big push for digital will not come until the second half of this decade.

Conventional communications will therefore provide the bulk of West Germany's business for some time to come, but that will not be a hardship, considering the long-term growth prospects of 5% to 6% a year. For 1984, market watchers at Siemens anticipate a real gain of 6% both for the public and the private communications sectors. Siemens has a big cash generator in its EMS private branch exchange systems, switches that have bagged orders for some 50,000 units during the past five years, making the company the world's biggest supplier of PBXs.

Commanding much attention these days are new data networks and transmission media—fields in which Europe's countries, both large and small, are investing heavily. In Switzerland, a packet-switching system called Telepac went into service in 1983, and local-area fiber-optic links for audio, video, and data transmission went into trial operation. Similar tests are being run in West Germany and elsewhere. This year, the Swiss will test videotex services and a 140-Mb/s long-distance fiber-optic link.

Despite the activity percolating through Europe's terrestrial nets, New York market research firm Frost & Sullivan Inc. sees strong long-term growth for satellite communications. It pegs the value of the satellites Europe will put into orbit by 1992 at $3.3 billion. Ground terminals will account for $2.9 billion more and sea-based terminals for a further $400 million.

Seeing is receiving. Switzerland's 140-Mb/s long-distance fiber-optic link will allow the transmission and reception of videophone signals. A camera (at top of TV set) picks up image and transmits it to receiving party where image is displayed on TV set.

Meanwhile, teletex is taking off in some European countries. A supertelex service for text communications between electronic typewriters with storage capabilities, teletex can transmit a two-page letter in 15 seconds. In West Germany, for example, some 5,000 teletex terminals were in use at the start of this year, and the German post office predicts that by the end of 1985, about 14,000 units will be installed—and 90,000 by 1990. A study by British market researchers Mackintosh Consultants Co. Ltd. in Luton, Bedfordshire, UK, puts the worldwide annual demand tor teletex-compatible gear at around $2.7 billion by 1992.

One market still in its embryonic stage in Europe—but expected to take off soon—is cellular radio. Frost & Sullivan sees more than 1 million Europeans using cellular radio by 1992, when some 370,000 mobile radiotelephone sets, valued at $465 million, will be delivered.

Sea changes

The British telecommunications sector is still undergoing sea changes—a technological overhaul from electromechanical to advanced microcircuit technology, and a political one that is transferring British Telecom from the state to the private sector. While the significance of these two events is profound, their dynamics have yet to work through the system.

An example is the effect on London-based Plessey Co., British Telecom's leading supplier for its System X digital exchanges. For the year ending in May, sales of Plessey's telecommunications division, which accounts for about half the company's sales, were up by 13%. But System X public-exchange business is now cranking up fast and entering the volume phase. Plessey has received British Telecom orders for more than $208 million for 228 local and trunk exchanges, according to Frank Chorley, who heads the firm's telecommunications business. Plessey expects that this fiscal year, System X orders will total about $152 million. So far, 13 System X exchanges have been installed, and more than 200 are to be delivered to British Telecom by year end.

The data-transmission market is booming, too. Such companies as Racal tries to go from 0.93 million units in 1983 to 1.10 million units in 1984 and to 1.28 million units in 1985.

Thus, for all of Western Europe, the Grundig predictions are for sales of 5.6 million (1983), 6 million (1984), and 6.6 million (1985) units. For the U.S., the corresponding figures are 4.1, 6, and 7.5 million. Worldwide VCR sales should hit 16.5, 20.5, and 25 million units.

Keen competition

Besides growth, competition is also making the VCR market interesting to watch. But the sales battle has already been lost to Japan's VHS system, with Europe's Philips and Grundig having all but conceded defeat of their jointly developed Video 2000 system. In its home market, Grundig holds a share of only 15%. In other European countries, except the UK, the Video 2000 checks in at a rather poor second but still ahead of Japan's Betamax system, the German firm says. The UK market is almost entirely in Japanese hands.

To continue participating in the VCR market and to improve their position, Philips and Grundig will produce and sell the hitherto-rival VHS equipment while still making the Video 2000 gear. At Grundig, 40% of production capacity will be devoted to Video 2000 and 60% to VHS. Grundig's reason for building the Japanese system is that without VHS equipment in its product range, its color TV sales would suffer in countries where it still has a strong position—for example, Argentina, Turkey, Iran, India, Indonesia, Thailand, and Saudi Arabia—as many customers buy their color receiver and VCR from the same supplier.

Slowing down. Color televisions, while still the backbone of the Western European consumer electronics market, are expected to start a slow decline in sales over the next few years. Sales of other products, such as video cassette recorders, will pick up the slack.

As for VCR saturation, according to the European Commission in Brussels, 20.5% of West German households will have a video recorder by the end of this year. For the UK, the corresponding figure is 35%, and for the Netherlands, 19.8%.

But brisk video sales and a stable TV market do not necessarily mean all is well in Europe's entertainment electronics markets. In West Germany, for example, the first quarter of this year saw a drop of 2% in consumer electronics sales for the industry as a whole. This came after a year, 1983, when the sales increase was a paltry 1%. That performance brought West Germany's entertainment electronics industry's total to approximately $5.5 billion.

German producers and dealers are now hoping that the Olympic games in Los Angeles will give the video and TV sector a lift, even though the games have suffered somewhat because most Eastern European countries have refused to attend. All told, though, for 1984 the German entertainment electronics industry expects an overall gain of 3%.

Not so Europe's audio sector, which should keep declining, despite the strong growth of compact-disk players. Market observers see the compact disk becoming the main music medium by the end of this decade. By 1986, they say, between 2.7 and 2.8 million disk systems will have been sold in Western Europe. Video disks, on the other hand, will not gain a significant share of the video market for some time.

The British VCR market is probably the first outside Japan to have reached maturity, and the UK will be virtually the only country where VCR sales will decline this year. Underscoring this rapid change in the supply situation, Japanese figures for February show a 47% fall in shipments to the UK, where by the end of 1984 some 40% of the homes that have televisions will also have a VCR. This rate is second only to Japan, which will have a penetration of 43.4%, according to a survey published by London-based *Screen Digest*, a trade publication.

Still, the UK remains the third largest market in the world for VCRs and will buy an expected 1.9 million of the machines in 1984, compared with 2.1 million last year. In West Germany, only 25.3% of the homes that have a TV will have a VCR by the end of 1984, and sales on the weak French market will come to only one quarter the UK market's level. Italy, Europe's most feeble market, will finish with sales of 150,000 VCRs by the year-end, which corresponds to only 3.2% of TV-owning households.

Much of this demand has been met by imports but, notes W. Greenwell & Co. Ltd., a London brokerage firm, some 20 VCR factories are now in production or under construction in Europe. Many of these will achieve 45%-by-value European content to conform with agreements reached between the European Commission and Japan's Ministry of International Trade and Industry, and will thus be outside existing volume restrictions.

TV sets peak

Like VCR sales, sales of color televisions in the UK also peaked in 1983 at around 3.4 million sets and will probably settle at around 3 million units in 1984. The 1983 peak corresponds to a replacement cycle following the color TV boom of the early 1970s. Since then, households buying second TVs has become a major sales factor, with 12- to 14-in. color sets selling for $200 to $240 keeping sales buoyant.

Without doubt, the consumer field is the Achilles' heel of the French electronics industry. In the color TV market, for example, after a drop of 10% in the number of sets sold during 1982, sales remained virtually unchanged

TABLE: 1983 COMPUTER SALES OF JAPAN'S LEADING COMPUTER FIRMS
(BILLIONS OF DOLLARS: 235 YEN = $1)

Company	Total sales	Domestic sales	Exports
Fujitsu Ltd.	2.8	2.3	0.5
IBM-Japan	2.6	2.0	0.6
NEC Corp.	2.2	1.9	0.3
Hitachi Ltd.	1.9	1.6	0.3
Toshiba	0.8	0.7	0.1
Oki Electric	0.7	0.5	0.2
Mitsubishi Electric	0.6	0.5	0.1
Nippon Univac	0.1	0.1	—
NCR-Japan	0.1	0.1	—

SOURCE: NIHON KEIZAI SHIMBUN

Executives at all major Japanese electronics companies agree that in the business market, consumer education has produced a greatly heightened awareness of the need for office automation equipment, especially integrated-network systems. "We expect 10% to 15% annual growth in central processing unit sales for the next several years," notes Toshiaki Katayama, manager of the Hitachi computer group's planning department. "We see 15% to 20% sales growth in peripherals and software over the same period."

Daizo Katoh, manager of NEC Corp.'s office automation systems division, thinks that his company is quite well positioned to increase its 16% share of the growing business-computer market. In addition, he is well aware of the 30% to 40% growth in sales of specialized terminals, like those used for airline reservation systems. Fujitsu Ltd. says that its business computer sales grew by 20% in fiscal 1983 and will do so again in the current fiscal year.

Because of the continuing lack of user-friendly systems for generating Chinese characters, the major firms see much slower growth in the home-computer market. To be sure, a survey by the *Nihon Keizai Shimbun,* a leading Japanese newspaper, shows that this market grew by 90% during fiscal year 1983. But according to Hiroaki Ishizaki, general manager of NEC's personal-computer planning office, that increase represented nothing more than 880,000 units.

"Even in the United States, there is not a wide general understanding of the varied uses of the computer in the home," Ishizaki says. "In Japan, even though we are introducing videotex and other services in the next few years, we really don't know how this home market will grow." At present, most of the growth comes from products based on Microsoft Corp.'s MSX hardware and software system, which has been priced at under $300 and is used mainly for games. Higher-end systems are growing at an annual rate that is no higher than 9%.

In the market for very large computers, IBM-Japan (with a 27.2% share), Fujitsu (20%), Hitachi (17%), and NEC (16%) dominate, with virtually no change in position since 1982. A Fujitsu executive says that disk-storage subsystems—which typically had memory capacities of 317 megabytes three years ago but are now available in the 1.8-to-2.5-gigabyte range—have the strongest growth potential. With office space at a premium in Japan, the demand for more compact storage systems is driving the market, and most makers predict annual growth of 10% to 15% both this year and next.

All major makers expect such future customer demands as speech, sound, and image processing, including ever more sophisticated computer-aided-design and -manufacturing functions. Hitachi stresses related software development, and 40% of its computer division's staff of 24,000 workers works solely on that. The firm has also created three spin-off companies in the last year just to develop software.

As for printers, laser models have positioned the market for a dramatic takeoff. According to statistics from the Japan Electronics Industries Promotion Association, domestic production of laser printers tripled to $24.6 million last year out of a total printer market of $1.86 billion, and the market will triple again this year.

up an extensive network for its new Tokyo headquarters.

When the telephone-receiver market is liberalized this fall and customers no longer are required to purchase their first sets from Nippon Telegraph and Telephone Public Corp., the market for this type of equipment will take off, industry executives predict. Even its rivals predict that a big winner will be Matsushita Electric Industrial Co., which is ready to flood the market with a variety of designs, priced as much as $10 lower than existing models.

Next year, an estimated 8.5 million new telephone sets will be sold for private and business use; the projected figure for 1988 is 12.4 million. In 1982, 3.8 million telephone sets with a value of $191 million were produced; this market is expected to grow to $630 million by 1988.

Another high-growth area is expected to be in what the Japanese call key telephones, which are usually used by small businesses that desire a central line with up to 20 extensions. Fujitsu says it will quadruple its production of such sets this year.

Use of facsimile machines, already widespread, grew another 33.4% last year with all Japanese facsimile-equipment makers reporting total revenues of $727 million, according to NEC's Bandoh. This year, with a new generation of machines—the G-4 digital facsimile—being introduced for use on NTT's digital-switching data network switching network, the market is expected to grow to $836 million, with continued strong market growth expected through 1985. The G-4 machines will increase data rate-flow from the present 9.6 kb/s to a maximum of 48 kb/s.

Overall, broadcast-equipment markets are flat, makers say, although growth in cellular radios is impressive. It was 15% last year, with 30% projected for 1984.

Competition is fierce as firms seek position, profits in industrial automation market

In industrial equipment, as in the consumer electronics market, Matsushita Electric Industrial Co. ranks first, with 1983 robot sales of $100 million and projected 1984 sales of $136 million. This figure is expected to grow to $174 million in 1985, according to an industry survey by *Nikkei Sangyo Shimbun*, a business journal.

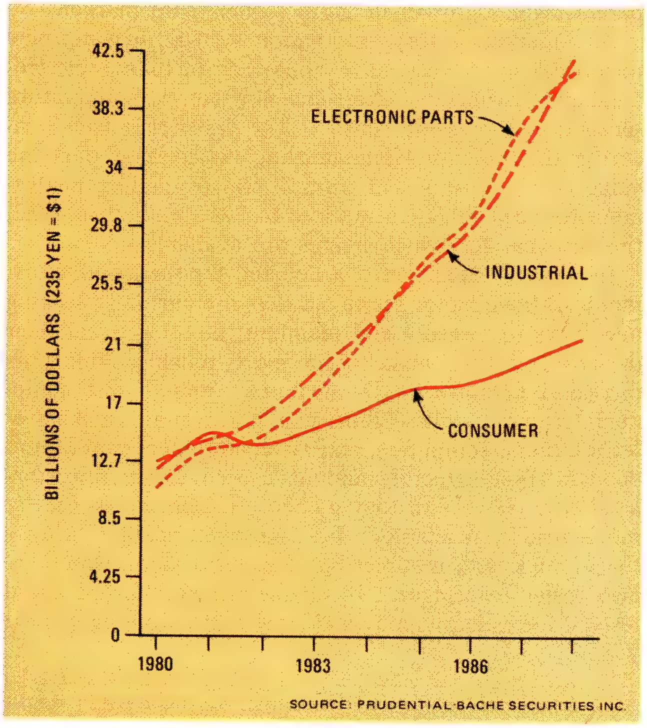
The other market leaders are Fanuc Ltd., Hitachi, Kawasaki Heavy Industries Ltd., and Yaskawa Electric Manufacturing Co. Ltd. As the market shifted toward more specialized end-user needs in the last three years, electric-equipment manufacturers such as Matsushita, Mitsubishi Electric, NEC, and Fuji Electric have entered the market, often to supply their in-house and subcontractor needs. Most of Matsushita's sales last year were in the category of electronic parts fitting for in-house use, and the company recently announced it has developed a robot for semiconductor-production cleanrooms.

The No. 2 maker, Fanuc, increased sales to $42.6 million last year—2.6 times 1982's level—primarily because of its 75% market share in numerical-control devices. Strong export demand from its joint venture, General Motors-Fanuc Inc., which grabbed an overall U.S. robot market share of 17% last year, also gave the firm a major boost. The most optimistic of the other Top 10 makers is Dainichikiko Co. Ltd., which forecasts that it will nearly double its 1983 sales of $27.2 million, thanks to its contract to remodel Jaguar Cars Ltd.'s main plant in England.

The entry of more than 100 companies into the market in the last three years has intensified competition to the extent that only five of the Top 25 makers met their sales goals last year, according to the *Nikkei Sangyo* survey. Last year's price-cutting war saw arc- and spot-welding models reduced by between 30% and 40%, forcing manufacturers to push higher-ticket factory-automation sales even harder (see chart).

In fact, factory-automation sales led to a 21.3% industry growth last year, with sales totaling $770 million, according to the Japan Industrial Robot Association (JIRA). A major portion of that growth was in equipment for the electronics industry, which for the first time surpassed the automobile industry as the leading purchaser of robots in the Japan market.

Assembly robots, says JIRA, will constitute close to 40% of 1984's robot production. The production value of playback robots, for example, was more than $220 million last year, an eight-fold increase over 1979. Production values of numerically controlled and intelligent ro-



SOURCE: PRUDENTIAL-BACHE SECURITIES INC.

Pro. As automation of production techniques continues, Japan's production of industrial electronic equipment will grow faster than consumer equipment, Prudential-Bache Securities estimates.

Building up. Competition is heating up in the industrial robot sector, as relative market newcomers—such as Mitsubishi Electric—join established firms in vying for business.

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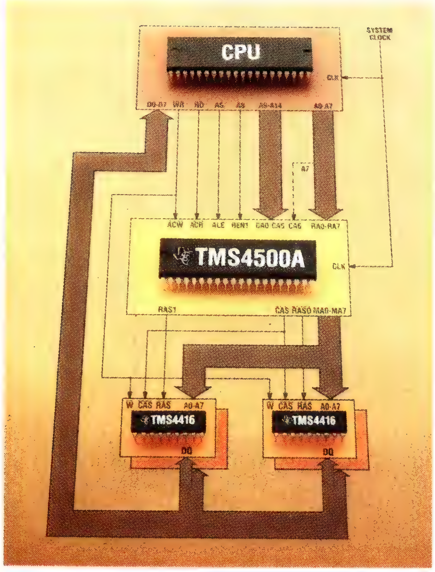

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TI's new TMS2150 cache address comparator can improve high-performance microprocessor or bit-slice system throughput by up to three times. Plus reduce cache memory IC count, board area, power dissipation, and cost.

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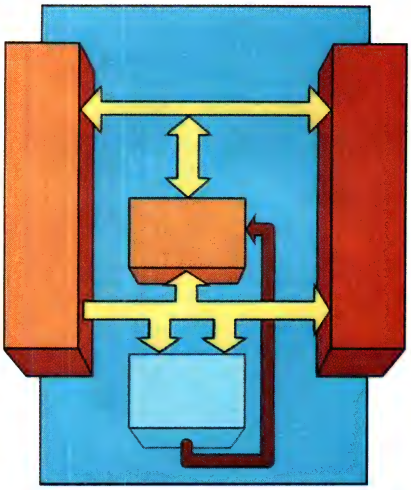
Operating from a single +5-V power supply, the TMS2150 consists of a high-speed 512×9 static RAM array, parity generator and checker, and a 9-bit high-speed comparator.



High-speed cache memory systems utilizing the TMS2150 will enable high-performance microprocessors to set new cost-performance standards with large, low-cost dynamic main memory.

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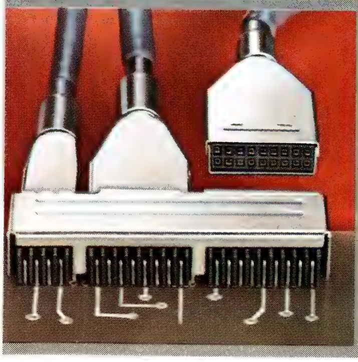

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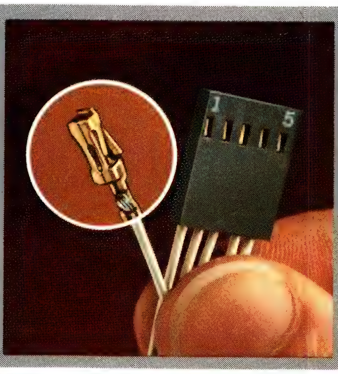

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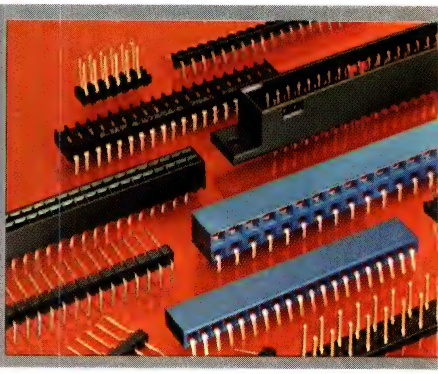

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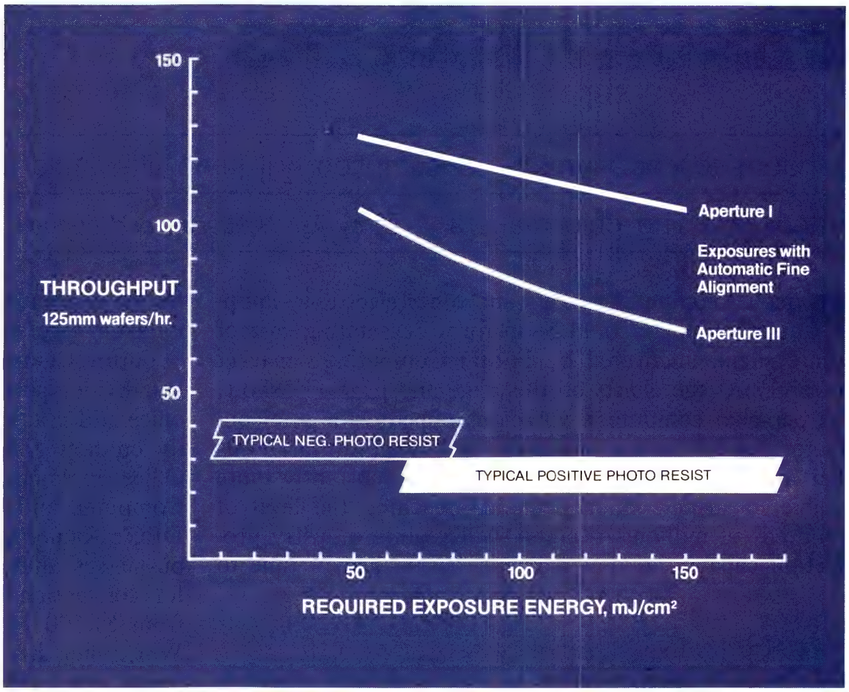

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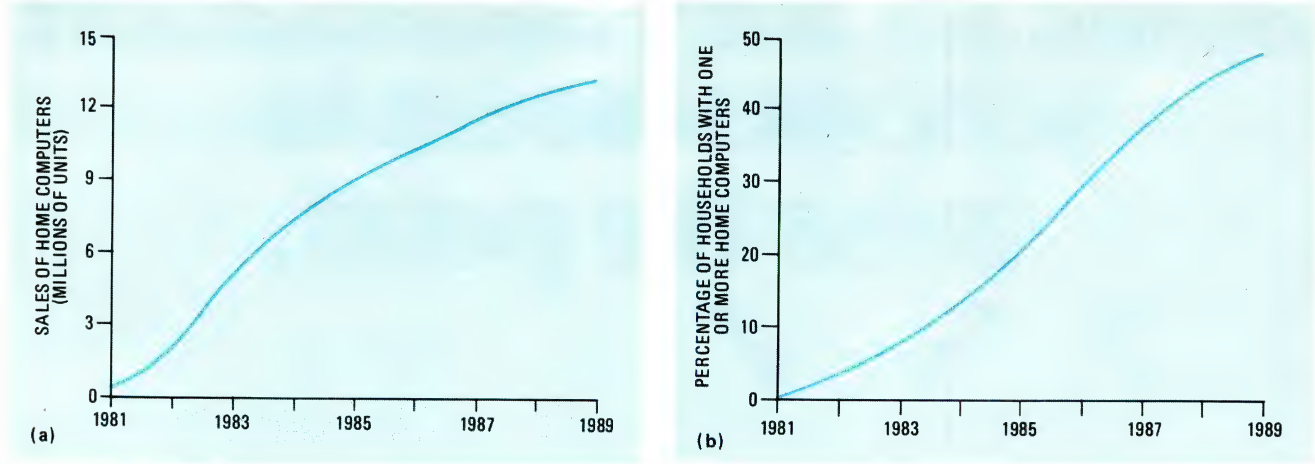
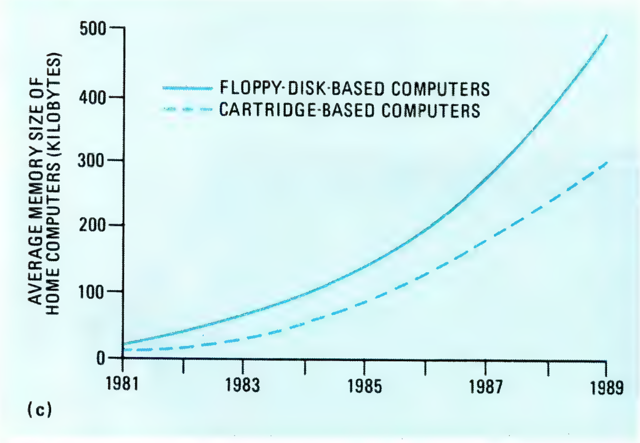




2. Home computers. Over 12 million home computers will be sold in 1989 (a), with half of U.S. households equipped with at least one unit (b). Memories for floppy-disk home systems will reach 500-K (c).

more sophisticated. The spreadsheets of 1980 were capable of running on the 48-K-byte personal computers of 1980—but in 1984, it is not at all unusual to find programs that require no less than 500-K bytes of memory. And operating systems evolving toward windowing need more memory, too.

Home computers—including the Commodore 64, the Atari 800XL, and the IBM PC*jr*—typically cost from $100 to $1,500, use cartridges or floppy-disk mass storage, and run home-productivity or game software. The Apple IIe and the IBM PC figure in both home and office markets.

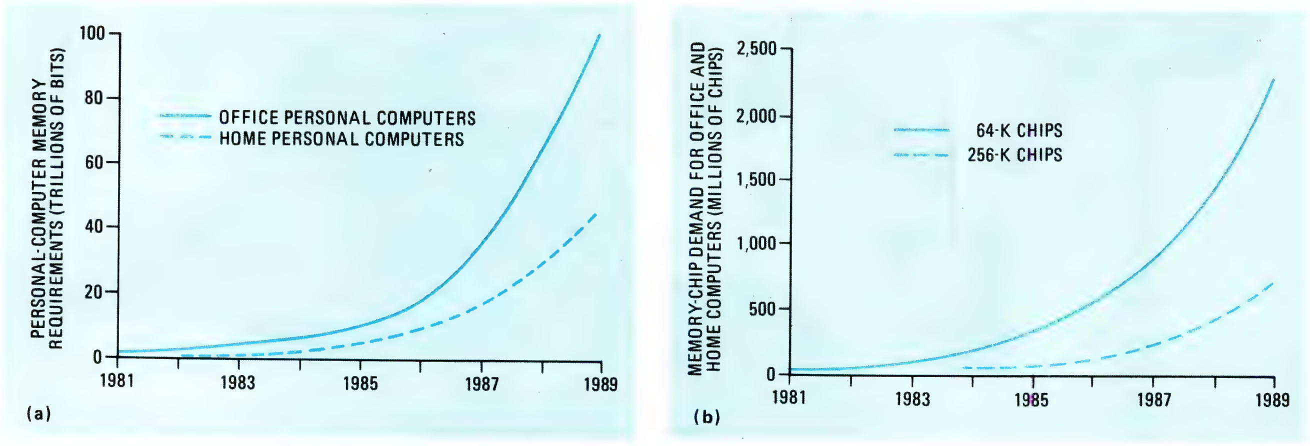
Yearly U.S. sales of home computers will probably double between 1984 and 1989 (Fig. 2a), so that by 1989 as many as 50% of all households may have them (Fig. 2b). As a comparison between Fig. 1a and Fig. 2a shows, significantly more home than office computers will be sold during the next five years. On average, however, home computers use distinctly less memory than office computers do.

Multiplying the number of personal computers of both classes by the average amount of memory in them produces an estimate of the number of memory bits personal computers will need for each year until 1989 (Fig. 3a). The same information can also be conveyed in a different form: estimates of the number of 64- or 256-kilobit memory chips that will be needed for all these personal computers (Fig. 3b).

To place the demand estimates in the proper context, remember that by 1989, the presence of an extra bit of memory, the parity bit, on each byte will require more memory for parity—in just one year—than was sold for all computers built before 1984. ☐

Egil Juliussen and Luanne Krause are on the staff of Future Computing Inc., Dallas, Texas.

3. Memory demand. In 1989, office computers in the U.S. will consume 105 trillion bits, while home computers will require an additional 43 trillion bits (a). More than 500 million 256-K, or more than two billion 64-K, RAM chips will be consumed in 1989 (b).



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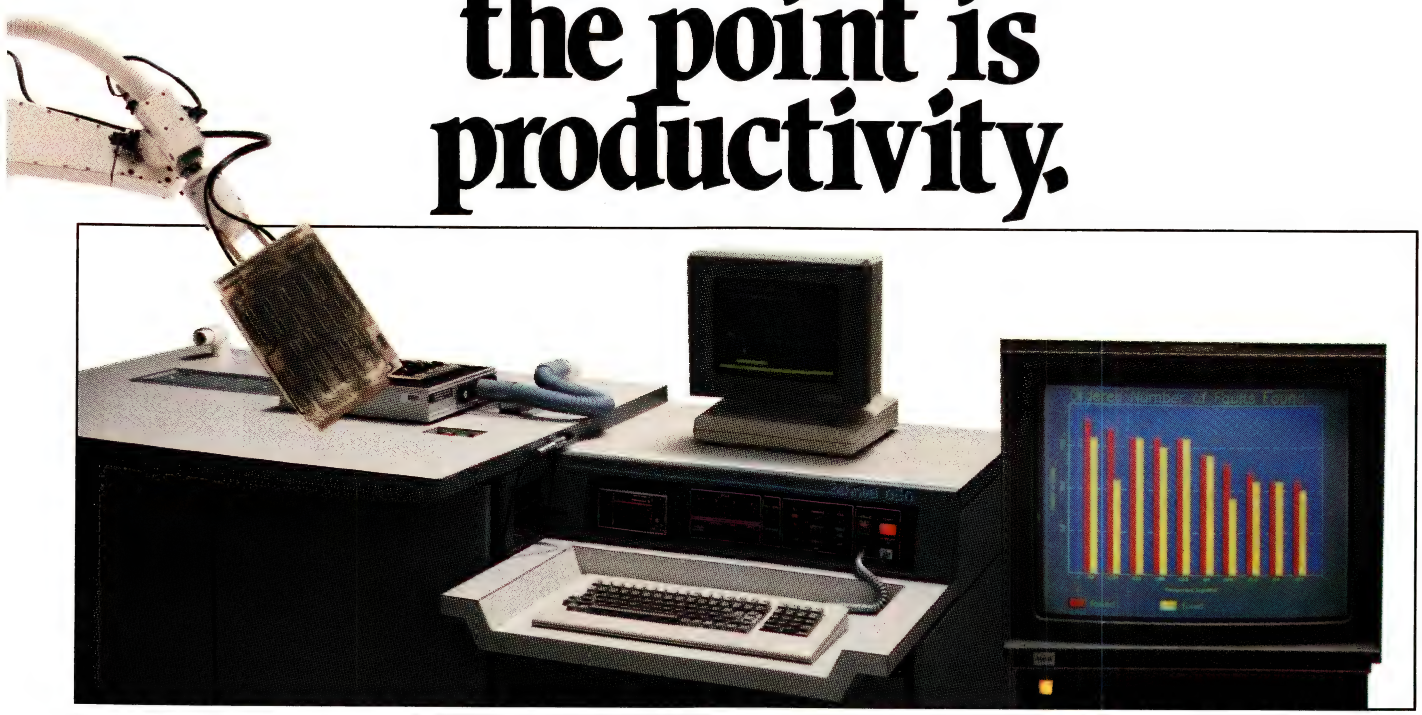

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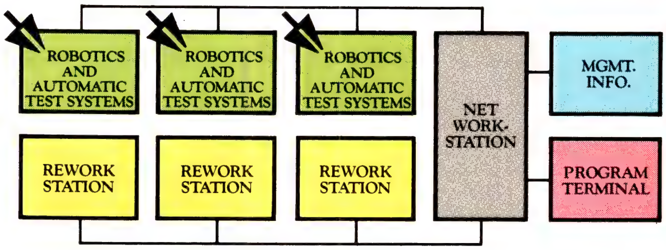
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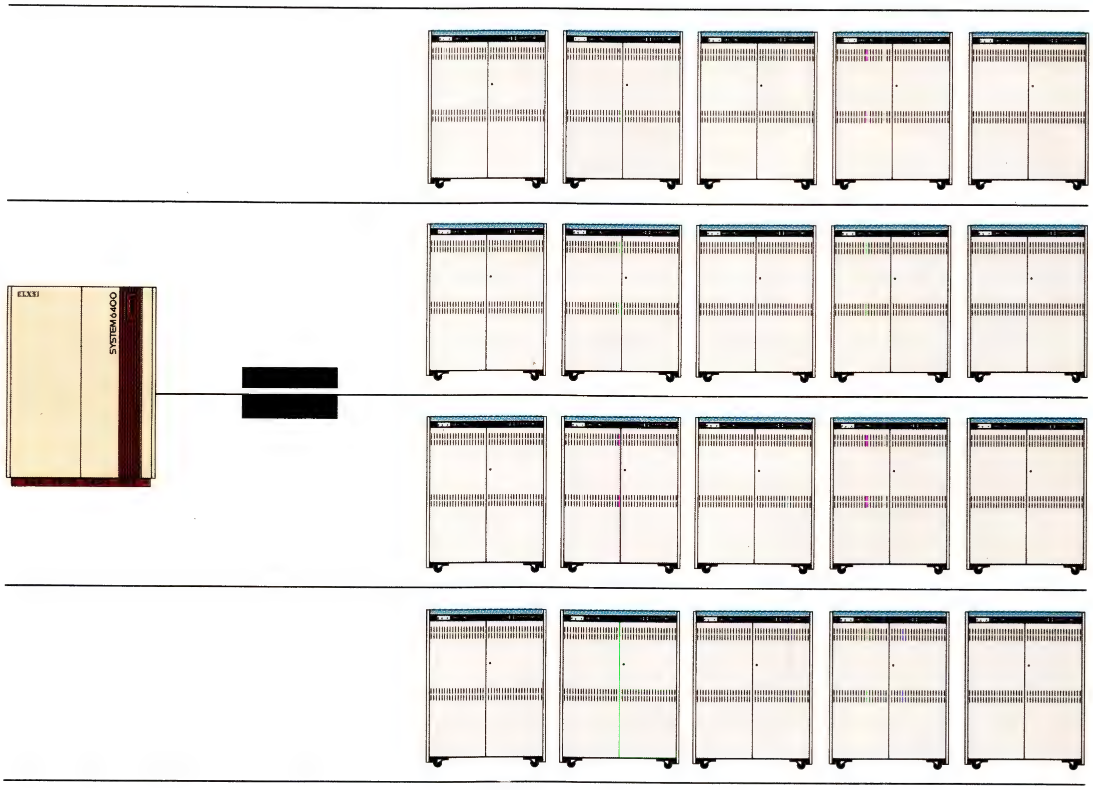

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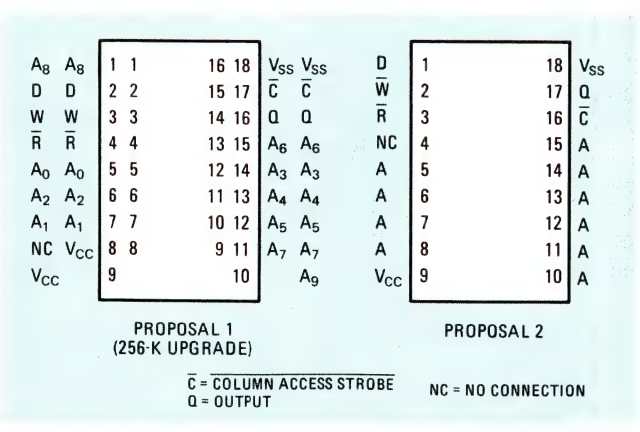
1-MB MEMORIES DEMAND NEW DESIGN CHOICES

Dynamic-RAM designers favor C-MOS with refractory-metal gate connections

☐ *by Lionel S. White Jr., Gregory J. Armstrong, and G. R. Mohan Rao*

Over the past several years, no group of digital integrated circuits has shown faster density growth or more significant advances in circuit design than dynamic random-access memories. Even as the 64-K dynamic RAM settles in as the standard computer-system memory and the 256-K dynamic RAM begins to fill a few system sockets, designers of very large-scale ICs are looking ahead to megabit dynamic RAMs and beyond. Though such dense chips will not be available in volume for some years to come, technical papers on their physical packaging, operational characteristics, and semiconductor-technology features have begun to surface at conferences worldwide.

One reason for starting early on the megabit-memory generation, which offers storage density 16 times that of 64-K and 4 times that of 256-K dynamic RAMs, is that it promises to raise a host of important issues and opportunities for systems designers. For example, instead of the 1-bit organization that dominates 16-K and (to some degree) 64-K chips, ICs with 1-Mb memories could be arranged in 4-, 8-, 9-bit, and other derivative organizations. Accelerating this trend is the introduction of such ICs as the multiport memory and proposals such as that for the 16-bit chip with multiplexed address and data lines. Thus, unlike 16- and many 64-K chips, the monolithic 1-Mb IC must be regarded as a family of memory ICs, not merely as a single chip.



1. One-megabit packages. In a 256-K upgrade pinout (left), an 18-pin-DIP socket can accept a 256-K or a 1-Mb dynamic random-access memory. A better approach for memory boards separates address lines from the control and data lines (right).

Although the 1-Mb IC will play a key role in the main memories of mainframes and minicomputers, it is destined for a dominant role in work stations as well as desktop and portable computers. If a portable computer incorporates a 1-Mb IC organized as 8- or 9-bit (allowing for a parity bit), a single chip would provide 128-K bytes of primary memory. In personal computers and work stations, main memory might require only four or eight ICs, depending on their organization. As a consequence, memory-system costs should be very attractive, while storage capacity and total system reliability increase significantly.

Technical issues

Before 1-Mb dynamic RAMs are available commercially in volume, system designers should be apprised of the technical issues that will affect product design. First, packaging and pinout options will alter traditional printed-circuit-board layouts, and a variety of packages will be offered. Dual in-line packages will have either 18 (1-bit) or 20 pins (4-bit), replacing today's 16-pin outlines. In addition, DIP widths will be either 300 or 400 mils, depending on the width of the die within a 1-Mb chip as well as evolving package technology.

Another issue concerns the operating mode of a 1-Mb dynamic RAM. The page mode has been standard for dynamic RAMs for many years, but the nibble mode, extended-nibble mode, and the new static-column decode are potential options for future chips. The increasing needs of dense-memory ICs with new memory architectures such as static-column decode will point to complementary-MOS as one possible dynamic-RAM technology. C-MOS, in fact, has many advantages over n-channel MOS, including lower standby-power consumption and, since basic C-MOS circuitry is simpler, shorter design time.

allows simultaneous random access to the RAM and serial access to an entire row (256 bits) of the RAM. This memory provides a higher bandwidth to refresh the video display and increases the amount of time that the graphics controller can use to update the display.

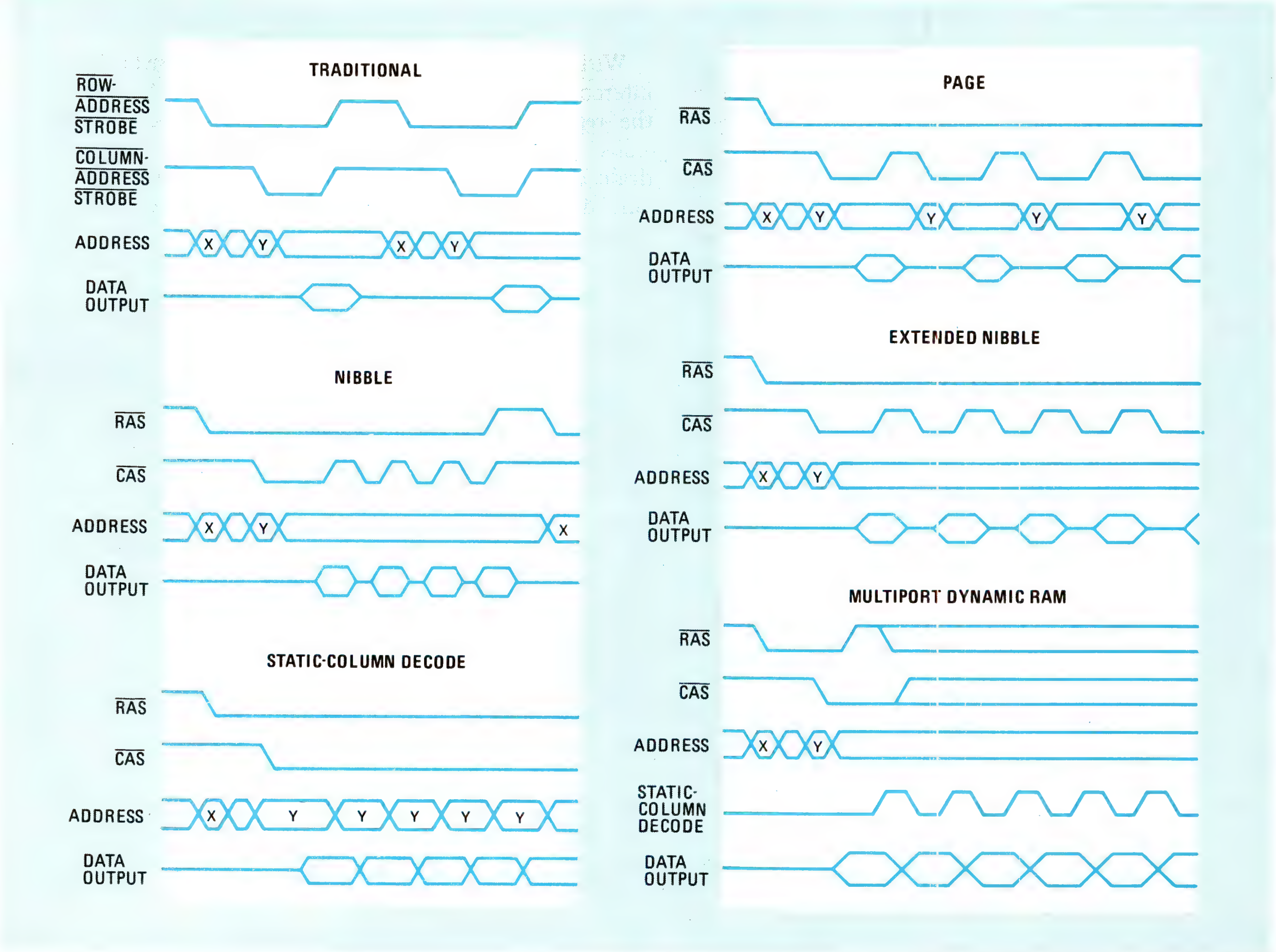
Static-column decode is the most recent technique to increase the bandwidth of the conventional 1-bit dynamic RAM. Static-column decode differs from the other modes in that the chip operates like a static RAM during the CAS portion of the cycle. In a typical access, the falling edge of RAS latches the row address and provides access to a row of bits (512 in a 256-K dynamic RAM). The falling edge of CAS provides static random access within the selected row of bits. Static-column-decode mode differs from conventional static-RAM operation in the timing related to the Write cycle. In the static-column-decode dynamic RAM, the data and addresses are latched on the falling edge of Write, whereas in a typical static RAM, the data is latched on the rising edge of Write and the addresses must remain valid throughout the Write operation.

Designing a static-column-decode dynamic RAM with C-MOS technology has one major advantage. During the cycle's static-access portion, the column-address buffers, decoders, and input/output circuitry must be powered up. If conventional static n-MOS circuitry were used, the active power dissipation would be excessive. But with C-MOS circuitry, the active power dissipation will be no worse than that consumed in other modes of operation. Using a C-MOS-based static-column decode, a data rate of 25 MHz (40 ns/bit) is feasible.

Swing to C-MOS

A key factor in increasing bandwidth is access to a larger number of bits during a single RAS cycle. Typically, dynamic RAMs are specified with a RAS low maximum time of 10 μs. This limit has been maintained over previous generations of dynamic RAMs for two reasons. The first is that the use of dynamic n-MOS circuitry designs in the peripheral circuitry of dynamic RAMs has limited the RAS low time because of the need to refresh the dynamic circuitry. Second, refresh-related tests take up most of the time in testing contemporary dynamic RAMs. Dramatically increasing the RAS low time would greatly increase the time and cost required to test the chips. Using C-MOS technology in the peripheral circuitry of the new dynamic RAMs, however, will diminish the requirement to test for the refresh characteristics of the peripheral circuitry. Thus, longer RAS low times may be allowed without significantly increasing the costs of testing the chip.

The trend toward C-MOS technology for advanced



3. Access modes. Page mode improves bandwidth by providing multiple random access to the currently addressed memory row. Nibble mode provides quick access to four adjacent memory locations. Multiport mode permits random access to the RAM and serial access to an entire row.

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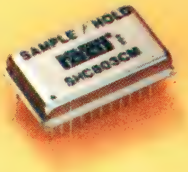

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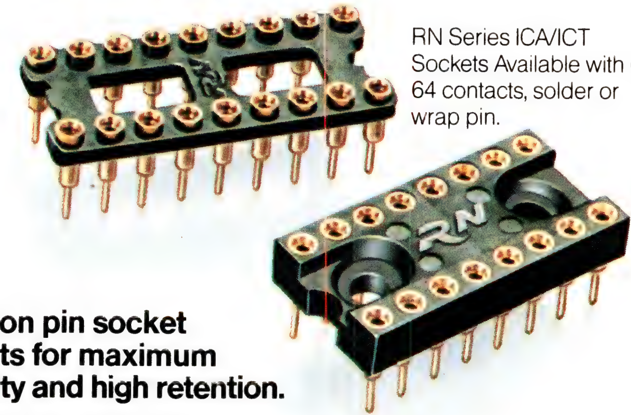

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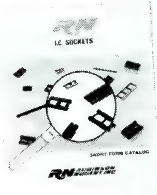

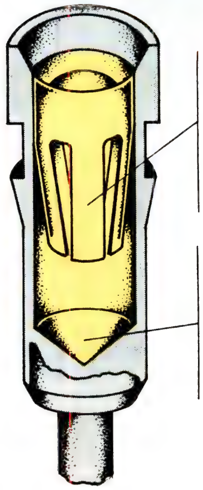

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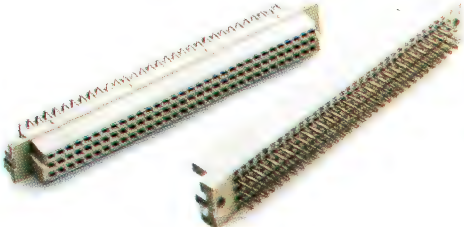

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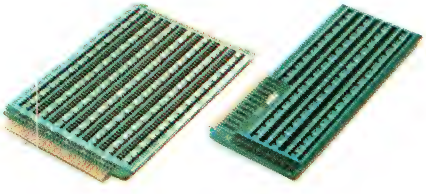

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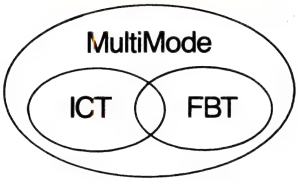

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Memory tester checks out 256-K RAMs

Special interface equips the memory tester to examine eight dynamic RAMS in parallel ☐ *by Steve Zollo, New Products Editor*

Powerful components such as 256-K random-access memories present many hurdles that system designers must overcome in using the parts. Testing is hardly the least costly and complex challenge. So to get testing costs down and prepare for the coming onslaught of 256-K RAMs, Teradyne is introducing the J386A-8 memory tester, which can examine eight address-multiplexed chips in parallel.

Teradyne's usual pattern of product improvement and introductions is to bring out a major memory tester at two-year intervals, but this schedule was speeded up because the company's customers called for higher throughput. The J386A-8, a companion to the J386A tester introduced just a year ago, doubles capacity from last year's model. However, that doubling costs only a 10% premium over the price of the J386A, which sells for about $180,000 to $200,000.

Parallel testing is the simultaneous functional testing of all chips under test. It reduces the time and therefore the cost of memory-chip testing and also raises throughput because the system can continue to test even if one or more test sites should fail to function or if a handler should jam. The trick to testing eight parts is in what Teradyne calls shared drivers.

To test eight single-output address-multiplexed RAMs on two four-site handlers, the eight-in-parallel operating mode uses a special interface in a shared-driver configuration. It connects each driver to two chip inputs through relays.

In the eight-in-parallel mode, the relays are controlled on a site-by-site basis only, so all shared pins (inputs) on all other chips are opened for dc parametric testing on a given device. Added by customer request is an alternate voltage-source-values feature; it essentially adds another voltage source level, so the testing function can be tuned more finely.

Operating modes. The J386A-8, which can undertake tests in the three operating modes available on the J386A, has an additional mode to examine eight 1-bit-wide address-multiplexed chips in parallel. Programs written for the J386A will run without modification on the J386A-8, which has a new control panel, five new test commands, and a new keyboard command. The existing three modes are for testing four 1-bit-wide address-multiplexed dynamic RAMs, two 4-bit-wide chips, and one byte-wide chip.

Teradyne's parallel software is designed to simplify writing a parallel program in Pascal. The parallel master operating program takes care of binning, data logging, and summary sheet information, as well as keeping track of which sites are enabled and which chips pass or fail—all without help from the chip test program. To make optimum use of parallel testing, programmers must be aware of parallel test strategies. For example, tests with the highest probability of producing failed chips should run first, so that bad chips do not take up sequential parametric test time. Functional testing, which takes the longest amount of time, should be done last.

For the parallel master operating program, the programmer writes the test program as if it were testing one chip; the master operating program

NUMBER OF DRIVERS, DETECTORS, AND VOLTAGE SOURCES PER TEST SITE

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Address drivers	9 (shared)	9	18	18
Data drivers	1 (shared)	1	4	8
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Detectors	1	1	4	8
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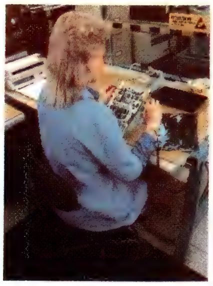

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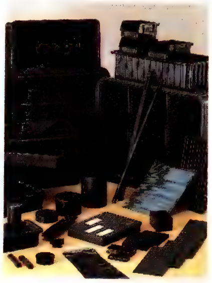

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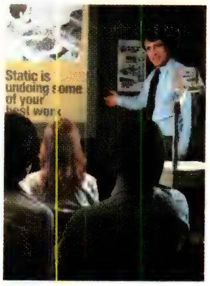

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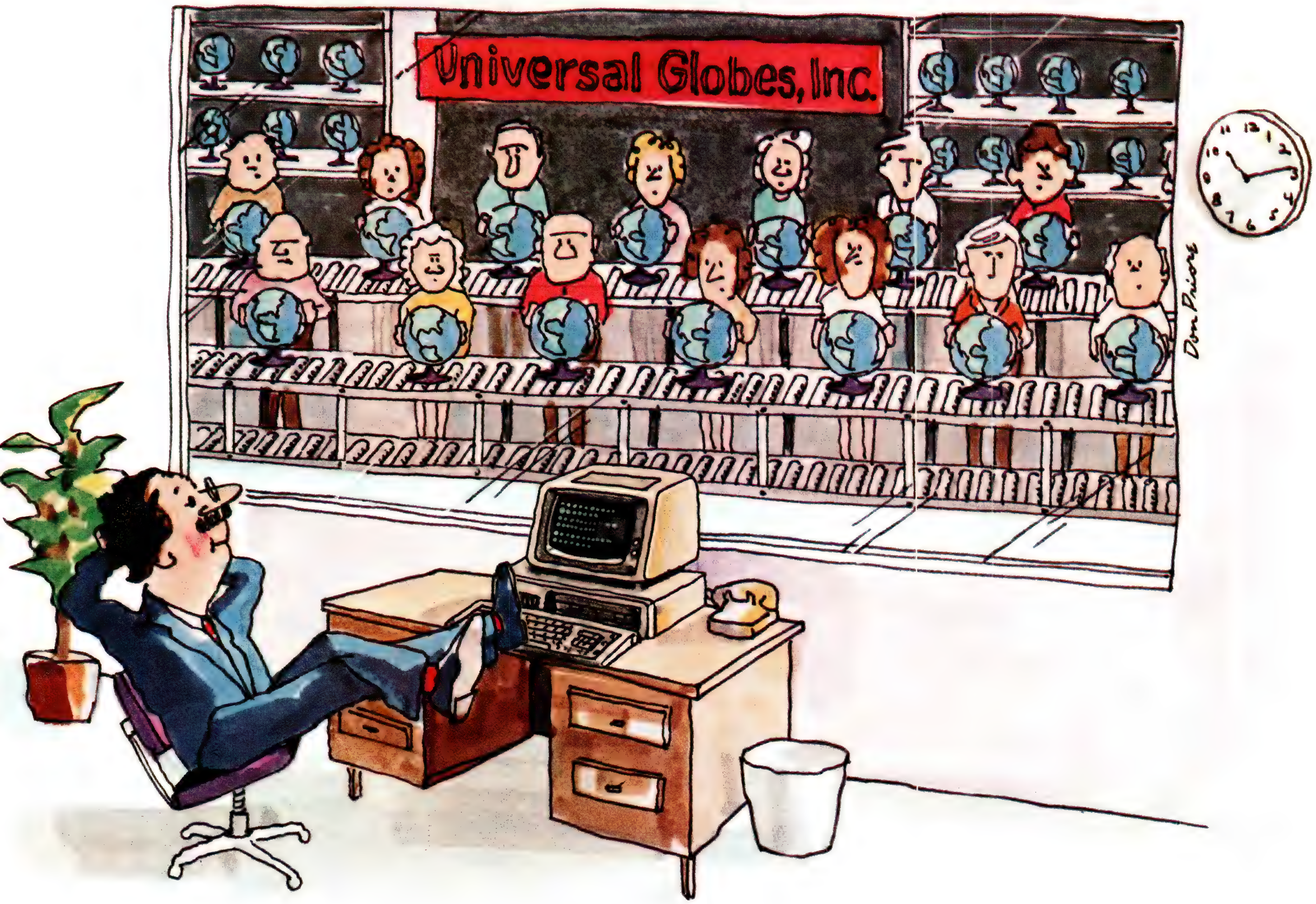

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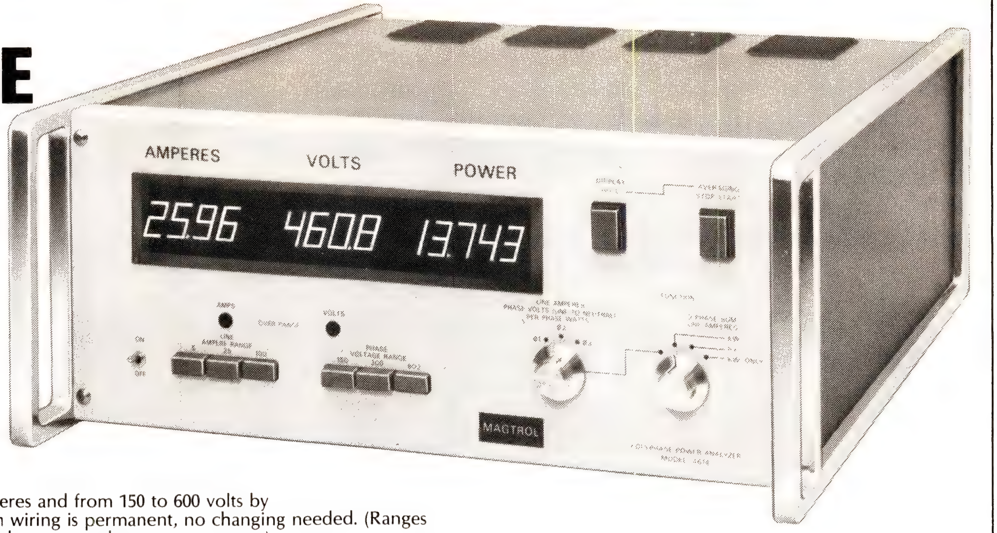

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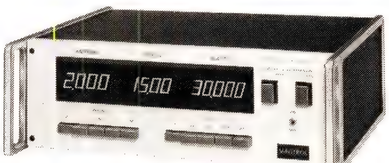

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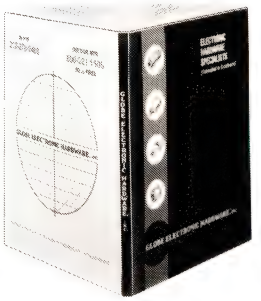

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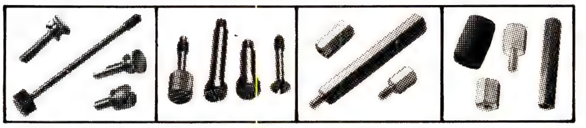

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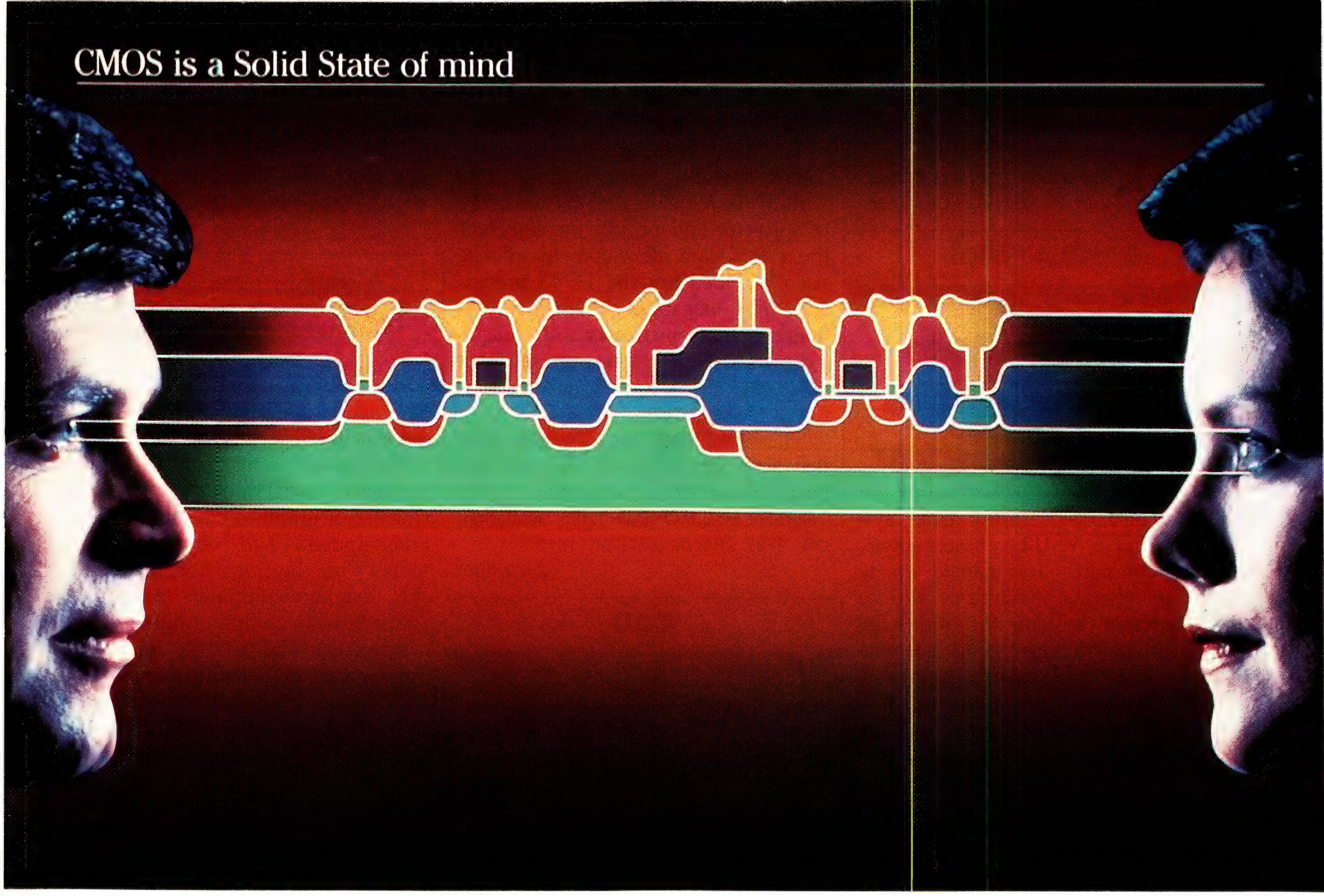
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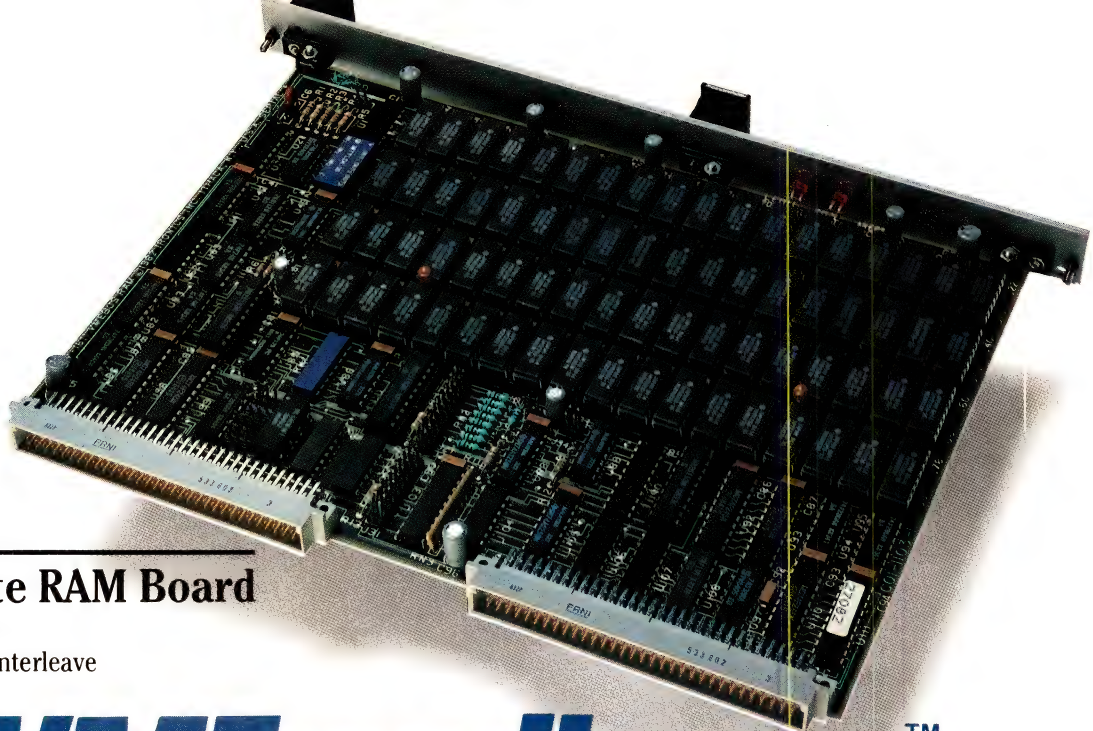

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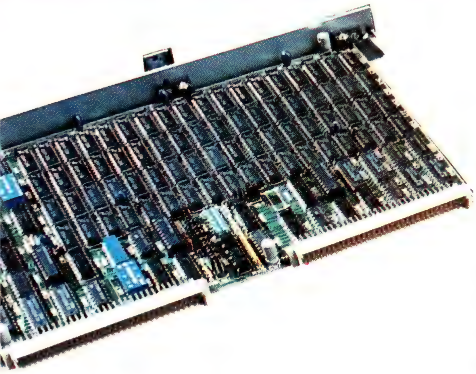

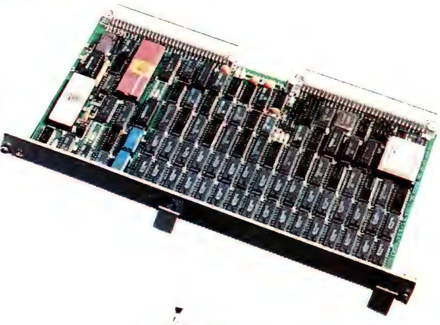

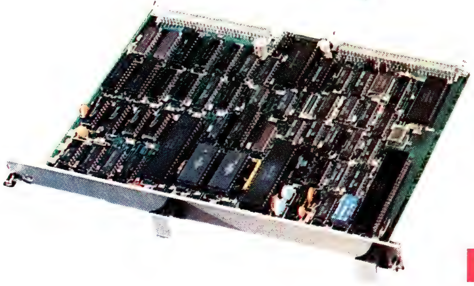

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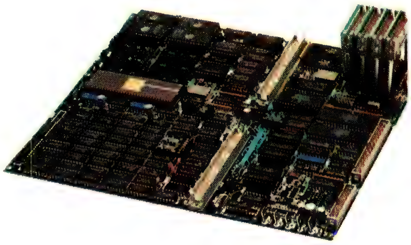

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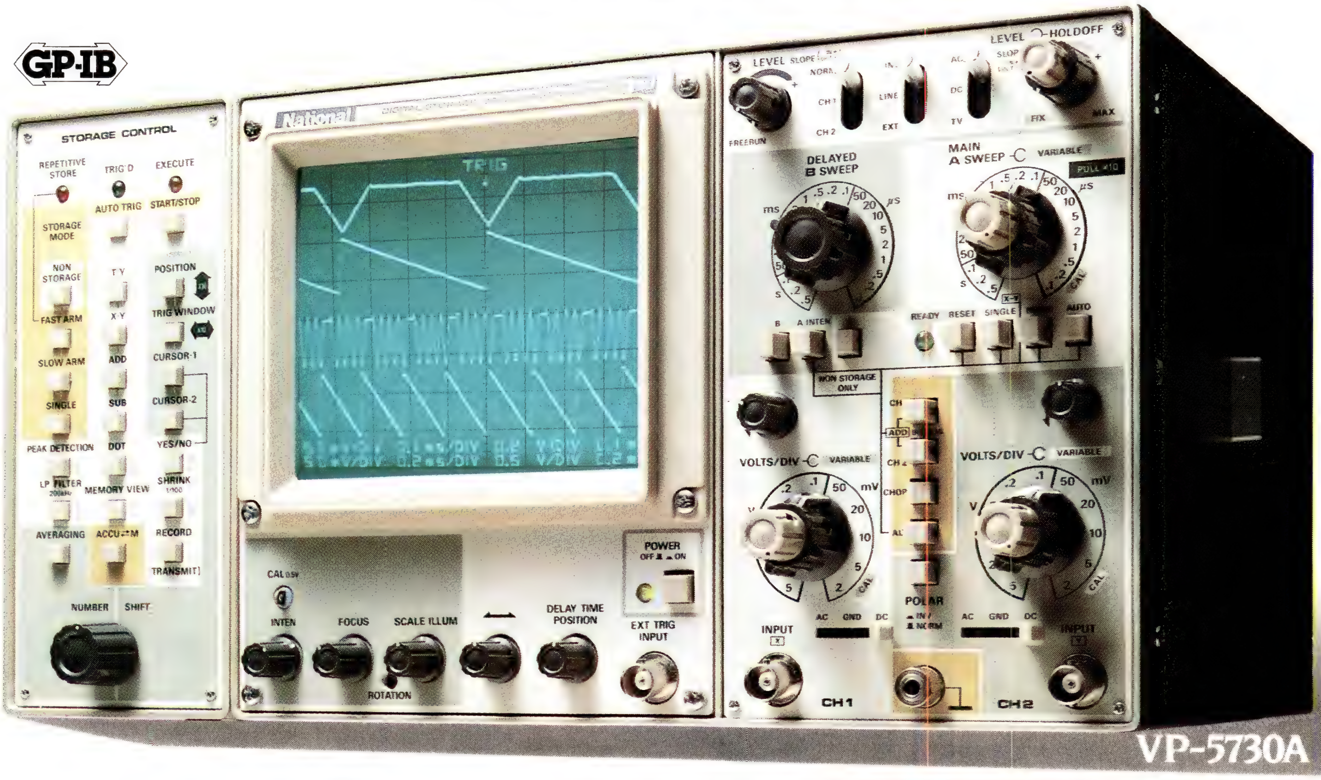
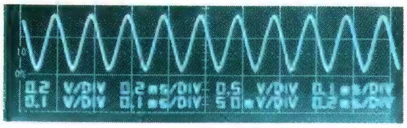


New National oscilloscope with digital display and peak detection also gives Yes/No signal judgements.

You, of course, get all the standard conveniences with the new National VP-5730A scope. But thanks to microprocessor technology, this model also thinks for you, remembers for you and even makes decisions for you.

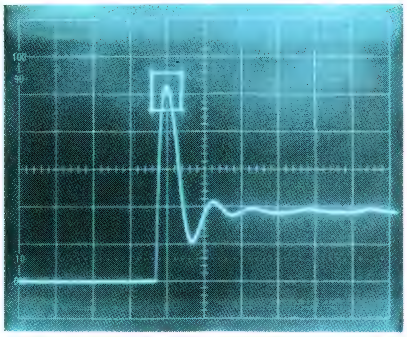
On-Screen Digital Readout

For easier measurements, the digital display shows not only measured waveforms but also trigger point, voltage and time differences with two cursor points, averaging time and other necessary information. Digitally, all at once and all on the screen.


0.2 V/DIV 0.2 ms/DIV 0.5 V/DIV 0.1 ms/DIV
0.1 V/DIV 0.1 ms/DIV 50mV/DIV 0.2 ms/DIV

Clear Yes or No Decisions

Set up your own parameters with the cursors for examing input signals and your VP-5730A also gives unequivocal "OK" or "No Way" answers—fast, efficient measurements which exclude any error-prone human judgement at all.



Peak Detection and Much More

With the peak detection feature you get single-shot and repeat signals for quick identification of aliasing, fast pulses and glitches, along with clearly displayed component signal envelopes. All this plus an optional interface (GP-IB) for various system applications, an average function, storage of repetitive signals, linear interpolation in place of dots for easy reading, and much more. So make the intelligent choice in oscilloscopes. Get the model that thinks for you—the VP-5730A Intelligent Digital Oscilloscope. From National.

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BAZAINE

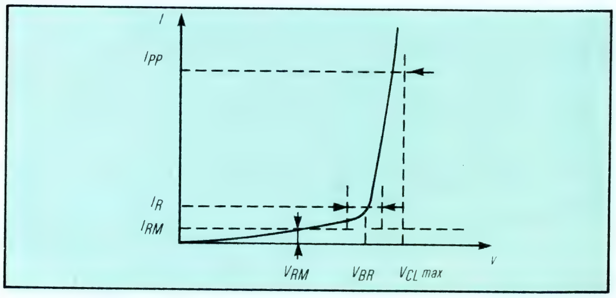
TRANSIL

UNI OR BIDIRECTIONAL DIODE

MAIN ELECTRICAL CHARACTERISTICS

- The peak reverse voltage V_{RM} is the voltage which the TRANSIL can withstand in continuous operation.
- The breakdown voltage V_{BR} is the voltage value above which the current in the TRANSIL increases very fast for a slight increase in voltage.
- The clamping voltage V_{CL} is the maximum value for the "standard" pulse with a peak value of Ipp, specified for any type of TRANSIL.
- TRANSIL's power dissipation (non repetitive operation) : a protecting device whose operation is adiabatic can dissipate the very same energy.

$$W = \int_0^{\tau} V_{CL}\, i\, dt$$



APPLICATIONS

TRANSIL can be used as protective devices whenever the load cannot handle overvoltages (limited by V_{CL}) or micro cut-off.

A COMPREHENSIVE RANGE

Type	P (W) 1 ms expo	V_{RM} (V)	Case
BZW 04 Series	400	5,5 to 376	F 126
BZW 06 Series	600	5,5 to 376	F 126
P6KE Series	600	5,5 to 376	CB 417
1.5 KE/PFZ Series	1500	5,5 to 376	CB 429/DO 27A

And for the protection of microprocessors, integrated circuits CMOS and MOS :

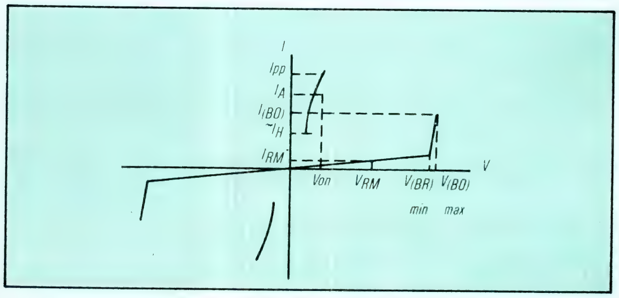
Type	P (W) 1 ms expo	V_{RM} (V)	Case
T.GMP5/GMP5 Series	600	5	F 126/CB 417
1 N 5908	1500	5	CB 429
ICTE Series	1500	5 to 45	CB 429

TRISIL

BIDIRECTIONAL DIODE

MAIN ELECTRICAL CHARACTERISTICS

- The peak reverse voltage V_{RM} is the voltage which the TRISIL can withstand in continuous operation with typical current I_{RM} of 5nA.
- The breakover voltage V_{BO} is the maximum voltage which the equipment to be protected will withstand. It is the breakover point from ON to OFF.
- Overload possibilities: these are only defined in the on-state. They permit the absorption of short transitory current (Ipp 8.20 µs) or high RMS currents (I_{TSM} 30 or 50 Arms/20 ms).
- The holding current I_H is that below which the TRISIL returns to the off position (V_{RM} - I_{RM}).



APPLICATIONS

TRISIL is designed to protect electronic sub-assemblies or low power components. The actual range covers a wide voltage range, V_{BO}, from 100 V to 300 V and holding currents of 120 mA and 180 mA. The precision of its triggering threshold and its small overall dimension allows it to be used for all vulnerable points of a system, particularly each time there is a connection with the outside world.

In telephony, TRISIL ensures the protection of telephones or any other equipment (modem - teleprinter) connected to a telephone line, against overvoltages from atmospheric origin or produced by accidental coupling with the mains.

THE RANGE

Type	V_{RM} (V)	Ipp (A) 1 ms expo	I_{TSM} (A) t = 20 ms	Case
TPA 100A-12 or 18↓ TPA 270B-12 or 18↓	90 to 243	50	30	F 126
TPB 100A-12 or 18 TPB 270B-12 or 18↓	90 to 243	100	50	CB 429

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5329

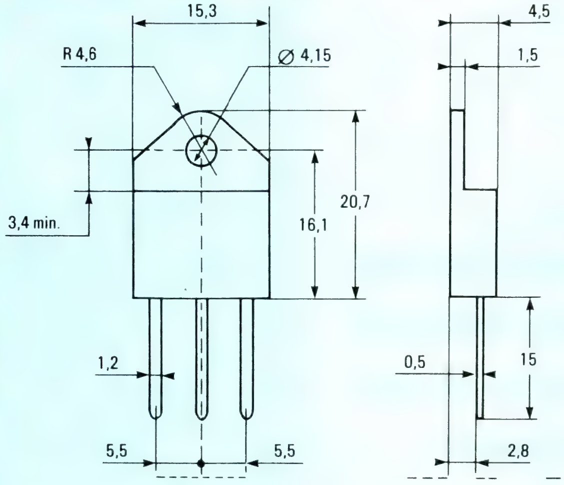
THYRISTORS
TRIACS - ALTERNISTORS

2500 V ISOLATION

The new generation of high power SCR's, triacs and alternistors in TOP 3 case feature isolated tab construction offering an isolation surge voltage in excess of 2500 Vrms (UL recognition pending). This standard feature offers considerable design advantages for equipment destined for use in consumer applications.

A COMPLETE NEW GENERATION OF DEVICES

Device	*Part number* *isolated tab*	 *non isolated tab*	$I_{T(RMS)}$	V_{DRM}
SCR	*BTW 68* *BTW 69*	*BTW 68.. N* *BTW 69.. N*	*25 A* *40 A*	*up to 1200 Volts*
TRIAC	*BTA 26* *BTA 41*	*BTB 26* *BTB 41*	*25 A* *40 A*	*up to 700 Volts*
ALTERNISTOR	*TPDV.. 25* *TPDV.. 40*		*25 A* *40 A*	*up to 1200 Volts*



TOP 3: Case outline

HIGH RELIABILITY

Extensive thermal cycling tests have proved the sustained reliability beyond 10 000 cycles of the TOP 3 isolated tab construction. The excellent thermal impedance and high reliability make the Thomson Semiconductors' TOP 3 triacs and thyristors well adapted to demanding applications such as welding supplies and heating control where thermal cycling is severe.

APPLICATIONS

SCR's:

The BTW 68 and 69 series of SCR's offer a revolutionary innovation by integrating isolated tab construction as a standard feature. Compared to traditional metal stud devices (TO 48) this new construction offers considerable cost saving and ease of assembly, leading to considerable design improvements in battery charger, welding, motor control and crowbar protection application areas.

Triacs:

The BTA/BTB 26 and BTA/BTB 41 triacs in TOP 3 case correspond to a natural continuation of Thomson Semiconductors' well proven range of TO 220 triacs. The advantage of isolated tab construction - easy assembly using a mounting clip and an optimised thermal impedance - are combined with the increased current carrying capability of the TOP 3 construction. This opens up a new spectrum of high power application areas such as motor speed control, solid state relays, heating and lighting regulation.

Alternistors:

The alternistor has been specifically developped for exceptionally demanding triac applications where high commutating dv/dt and di/dt ratings are required. Capable of switching at 200 V/µs at rated di/dt, the bidirectional alternistor is ideally suited to handling inductive loads and can advantageously replace two back-to-back thyristors thus drastically decreasing assembly costs.

In the same TOP 3 case, Thomson Semiconductors also proposes power transistors, fast recovery rectifiers and voltage regulators.

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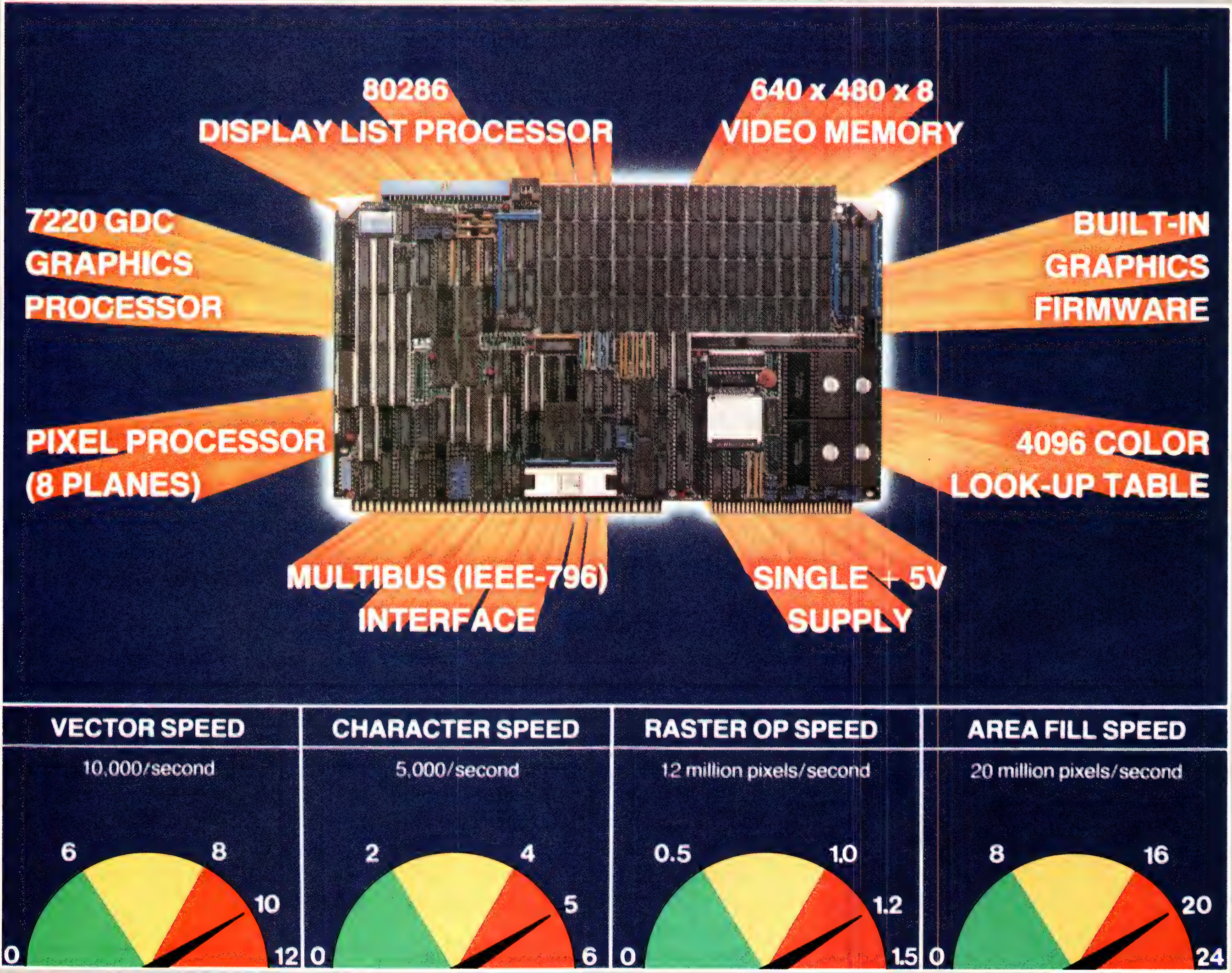
Circle 157 on reader service card

BREAKTHROUGH IN MULTIBUS GRAPHICS!



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The new Matrox SX-900 is a high performance color graphics display controller. It is the perfect solution for OEM manufacturers of process control and instrumentation equipment. The SX-900 is software compatible with the popular Matrox GXB-1000A high resolution display controllers, but occupies only a single Multibus card slot, and provides high speed drawing capability.

The hardware provides 640 x 480 pixel resolution, 4 or 8 bit planes, a 4096 color look-up table, and a 60Hz flicker free video refresh rate. The fast performance of the SX-900 results from a multi-processor pipelined architecture. A powerful 80286 CPU is used as the front end display list processor and is supported by a 7220 graphics primitive processor and a high speed pixel processor for simultaneous 8 plane drawing.

The SX-900 incorporates the proven on-board graphics firmware used by the GXB-1000. Over 256 high level display list commands are supported including line drawing, character drawing, circle and arc drawing, area fills, cursors and raster ops.

In addition to graphics boards, Matrox can also supply color monitors, cardcages, CPU cards, memory boards, and communications controllers for complete OEM display system requirements.

80286, MULTIBUS - TM INTEL • 7220 - TM NEC

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The HP 4951A features advanced one-button autoconfiguration which easily does the setup work for you and gets you monitoring data quickly on-line. Like the HP 4955A, it gives you 63 simultaneously active triggers for extensive testing. In post-processing mode, you can do detailed repetitive analysis for hard-to-track errors. You can trap on characters, error conditions and lead transitions. To isolate problems down to the network component level, BERT mode lets you measure bit errors, block errors, errored seconds, and percent error-free seconds. You can simulate a CPU, modem, terminal, or group of terminals for complete interactive testing. The HP 4951A accommodates most popular protocols, data codes, and speeds (to 19.2 kbps).

For more information on the HP 4951A and HP 4955A protocol analyzers, call your local HP sales office listed in the telephone directory white pages. Ask for the electronic instruments department.

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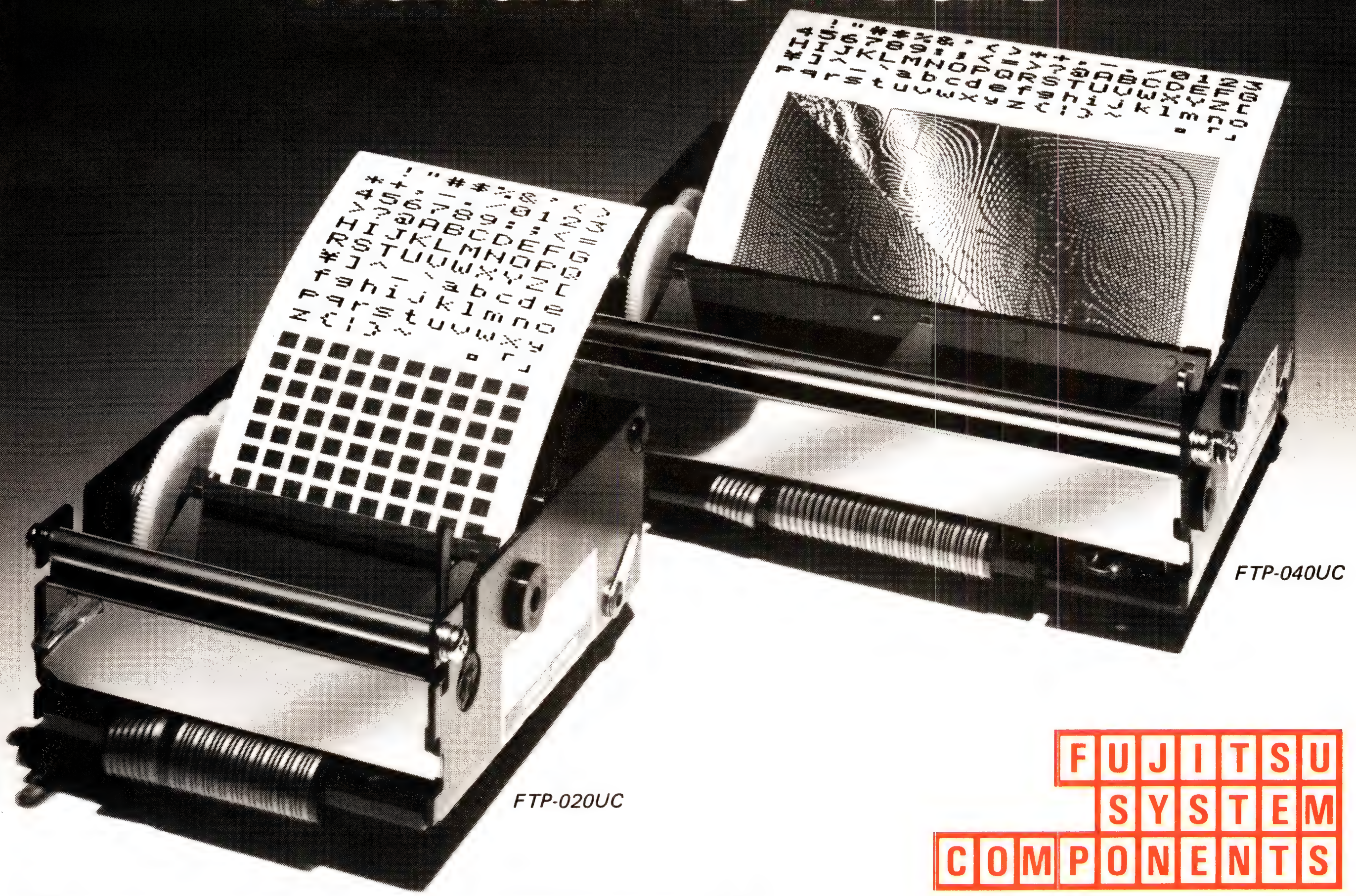
FUJITSU MINI-THERMAL PRINTERS

Easier to read. Harder to hear.



FUJITSU SYSTEM COMPONENTS

And much more!

Now there are versatile mini-thermal printers with a host of important features you have not been offered before – plus they do graphics and total blackouts!

- **CLEARER**

An advanced fixed print head and stable-contact forms are the secret. You'll get clarity that no other printer can match – even for detailed graphics.

- **QUIETER**

Head movement means noise. Fujitsu's stationary head design has virtually eliminated irritable printing noise – a welcome relief to any office.

- **FASTER**

At 80 characters per second, both models double the printing speed of conventional types so the job is finished in half the time.

- **MAINTENANCE-FREE**

No head movement, no maintenance problems. And their unique wear-resistant structure provides an operating life of up to 20 million dot lines.

Characteristics	FTP-020UC	FTP-040UC
Dot configuration	140 line dots	280 line dots
Dot pitch	70 dots/inch	
No. of printing columns	20 (5 x 7 dots)	40 (5 x 7 dots)
Character size	1.8 x 3.0 mm	
Printing speed	80 characters/sec.	
Printing paper width	60 mm	110 mm
Input interface	8-bit parallel (Centronics Standards)	
Power source	Logic section: 5VDC, 1A (max.) Head section: 24VDC, 2.5A (max.)	

Isn't it time you took advantage of all this? Contact Fujitsu Component Europe, B.V. for full details.

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Fujitsu Limited·Tokyo, Japan

Fujitsu Component Europe, B.V.:
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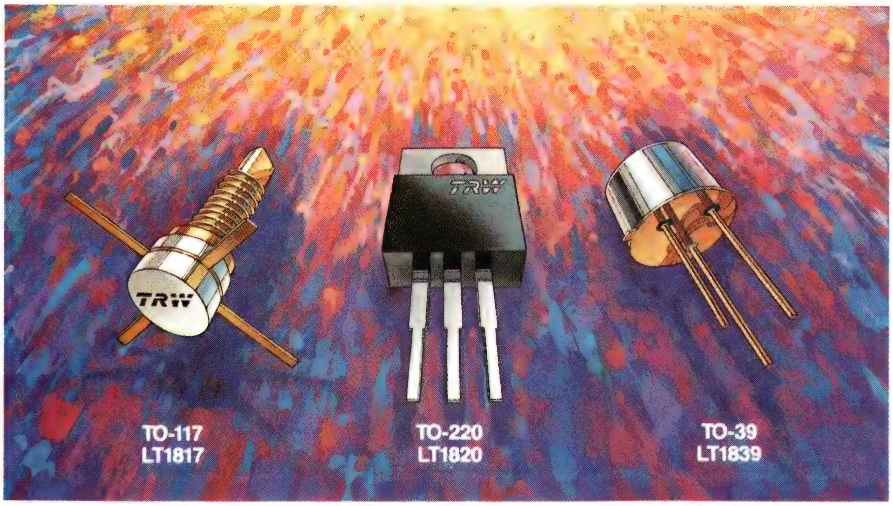
New CRT ultra-high resolution is now possible.

Also available in PNP

Get video bandwidth beyond 100 MHz with new TRW drivers.



A major hurdle in developing ultra-high resolution video graphics has been the absence of a fast, high voltage video driver transistor. Now TRW clears the way with three new bipolar CRT drivers! They're designed to meet the needs of graphic display systems for CAD/CAM, CAE, medical or other applications requiring ultra-high image definition.

These new CRT drivers combine high (120 volt) breakdowns with low output capacitance (<2 pf), and high speed ($f_m > 2$ GHz @ 80 mA). They're exceptionally rugged to withstand large amounts of current in BVcbo or BVces modes, and incorporate a proven reliable all gold monometallic metallization system.

Our new bipolar high resolution transistors come in three packages: TO-39 (LT1839), TO-117 (LT1817), and TO-220 (LT1820). These new transistors are priced in the $4 to $8 range in small quantities.

For additional technical information, and/or samples, contact Dan Brayton, Product Manager, RF Devices Division, TRW Electronics Group, 14520 Aviation Blvd., Lawndale, California 90260, phone 213.536.0888.

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See us in Booth 1308.

TRW

RF Devices Division
TRW Electronic Components Group

New TX Microwave/CRT Transistors for MIL-S-19500 applications

Choose from 11 TRW RF devices processed to the equivalent of JANTX, with full documentation available.*

When the RF performance level you want isn't readily available on the MIL-S-19500 Qualified Products List (QPL), try the TRW list of Standard REL Processed Devices. You'll find 11 microwave linear and CRT Z-Axis drivers REL processed to an integrity level equivalent to JANTX—and we supply all the documents you need for military use qualification. This means large savings to you because you eliminate masses of expensive drawings and possibly months of testing. All you do is fill out a one-page form—and we can even help you with that! It's that simple to get these parts qualified.

TRW STANDARD REL PROCESSED DEVICES

STANDARD PART NUMBER	STANDARD REL EQUIVALENT PART NUMBER		DESCRIPTION
LT1001A	TX1033	3.0GHz TO-39	Low Noise
LT1814	TX1814	High Voltage CRT	Z-Axis Driver GP-14 Stud
LT1839	TX1839	High Voltage CRT	Z-Axis Driver TO-39
TRW52501	TX52501	1.5W 2GHz GP-14	Common Emitter, Isolated Stud
TRW52502	TX52502	3.0W 2GHz GP-14	Common Emitter, Isolated Stud
TRW52601	TX52601	1.5W 2GHz HLP-8	Common Emitter, Grounded Flange
TRW52602	TX52602	3.0W 2GHz HLP-8	Common Emitter, Gounded Flange
TRW53501	TX53501	0.8W 3GHz GP-14	Common Emitter, Isolated Stud
TRW53601	TX53601	1.6W 3GHz HLP-8	Common Emitter, Gounded Flange
TRW54501	TX54501	0.5W 4GHz GP-14	Common Emitter, Isolated Stud
TRW54601	TX54601	0.5W 4GHz HLP-8	Common Emitter, Grounded Flange

You'll recognize TRW Standard REL Processed Devices by the "TX" prefix to their part numbers. And in small quantities (1-24) their U. S. price is in the $50 to $80 range.

The list of TRW TX devices includes two CRT drivers for ultra-high resolution featuring gain bandwidth of 1.2GHz and 130V breakdown and eight MIL-packaged microwave linear parts in studded or flanged versions with common emitter configurations offering f_T to 4GHz and powers to 3W. These units are processed according to MIL-S-19500 JANTX level and come with a Certificate of Compliance. Standard part pricing and off-the-shelf delivery through authorized TRW distributors.

For application note, which explains how easy it is to use and qualify these parts, contact RF Devices Division, TRW Electronic Components Group, 14520 Aviation Blvd., Lawndale, California 90260, phone 213.536.0888.

*Available now through your local TRW distributor.

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TRW

RF Devices Division
TRW Electronic Components Group
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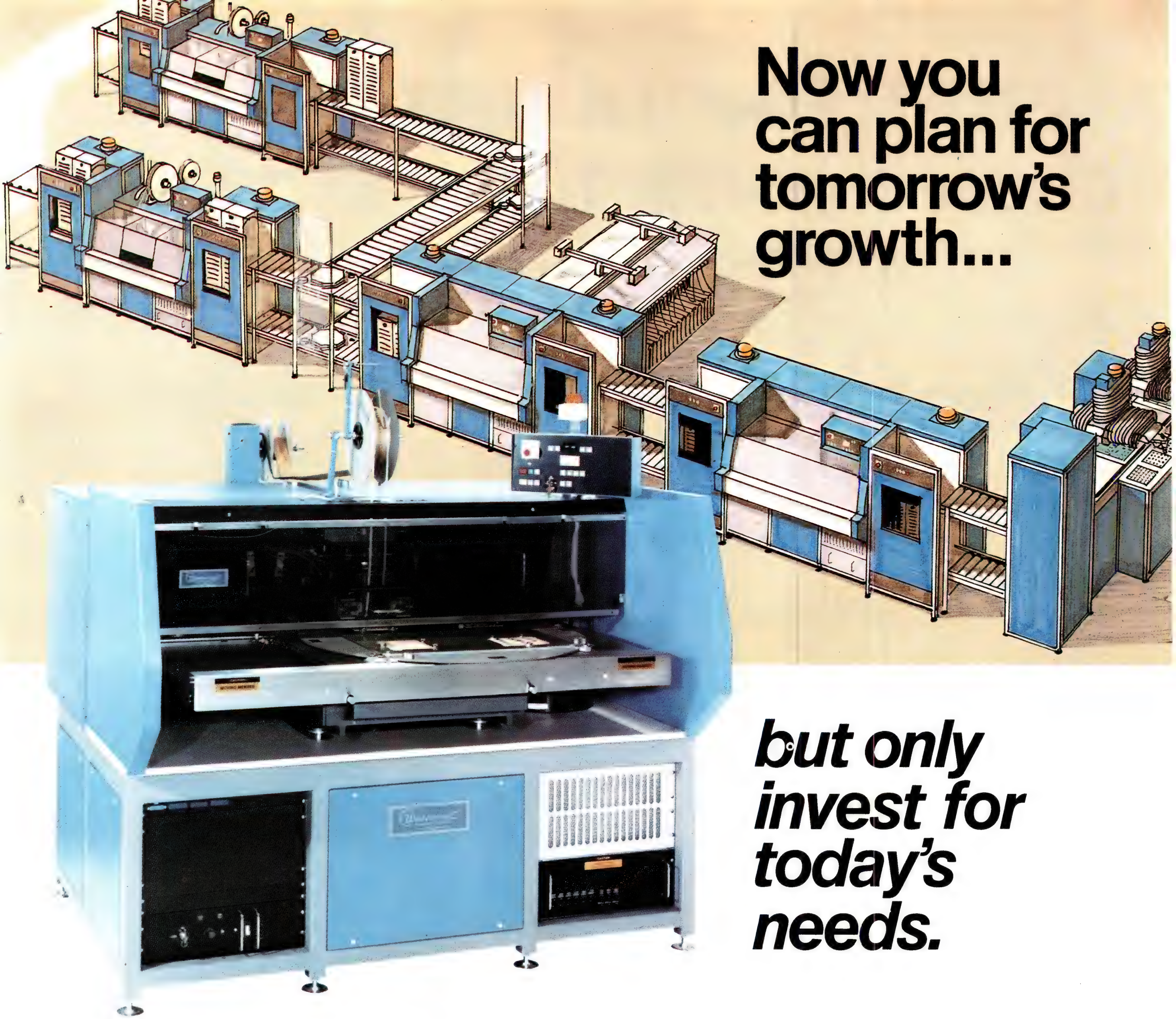

Now you can plan for tomorrow's growth...

but only invest for today's needs.

In the sometimes confusing world that spans from automatic component insertion and parts placement to full factory automation, there are two guidelines worth remembering:

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Universal's Sales Engineers and Factory Automation Specialists will welcome an opportunity to analyze your current and projected needs and show you how your company can benefit from the increased production and improved product reliability that only Universal's electronic assembly systems can provide. Contact your Universal sales office or send for more information.

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Oak's Series 225 low-profile keyboard switch provides the rugged construction, tactile feel and quality so important in hi-rel applications. This ½" square switch is available with profiles of 0.225" or 0.300", in a variety of keycap colors.

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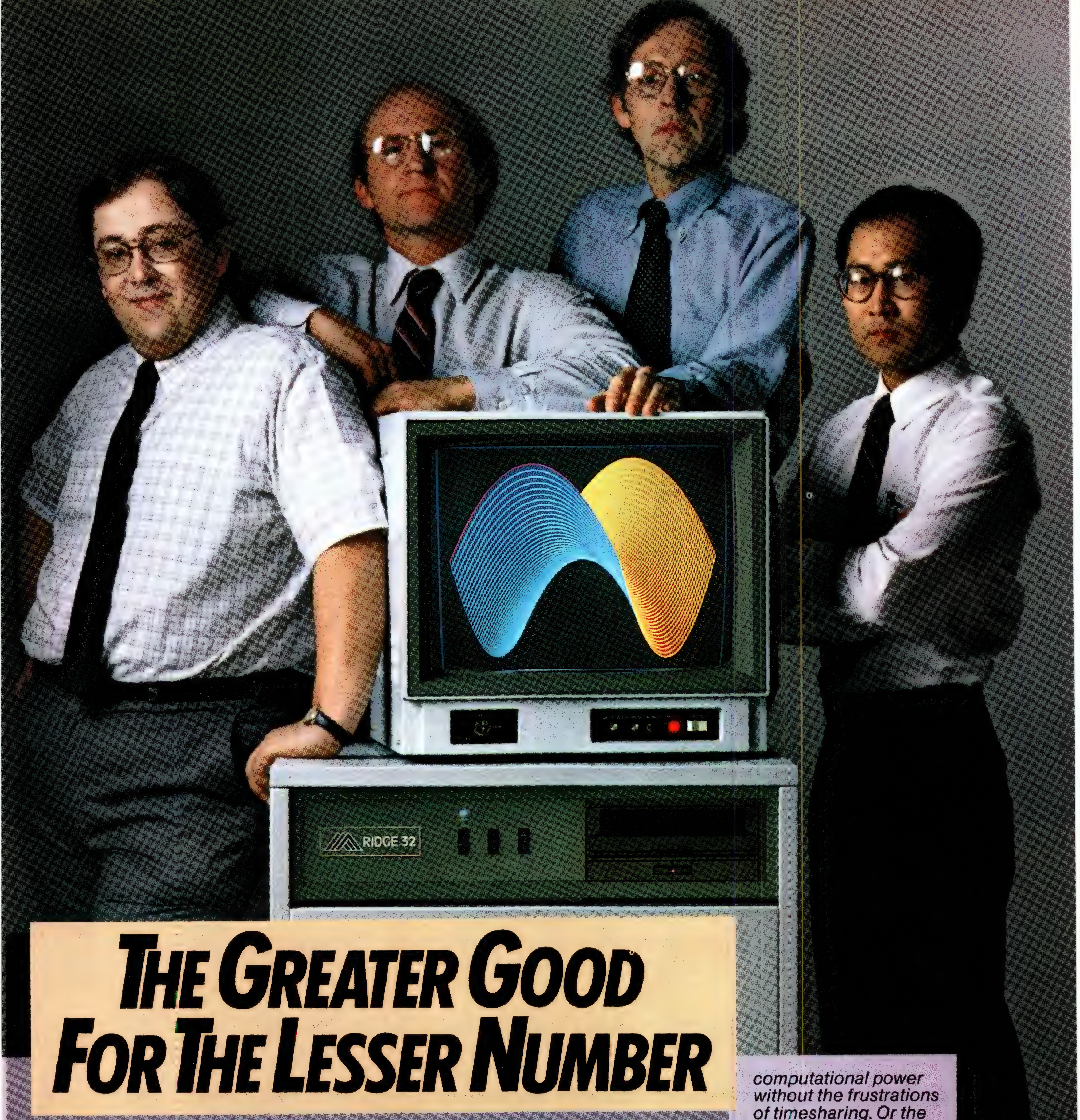

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APPLE II, IIe & IIc Compatible
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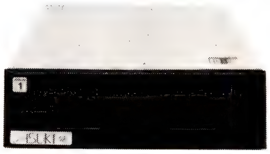

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- Low profile, high performance.
- 40 tracks available.
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NF-555	5¼	1D	Apple II&IIe	250K	48
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NF-051	5¼	1D	Shugart	250K	48
NF-502	5¼	2D	Shugart	500K	48

※Apple II, IIe & IIc are the registered trademarks of Apple Computer Inc.

Mechanism

	Size(inch)	Type	Capacity(byte)	Track Density(TPI)
F-051	5¼	1D	250K	48
F-502	5¼	2D	500K	48
F-301	3	1D	250K	100
F-351	3½	1D	250K	67.5
F-353	3½	1DD	500K	135
F-352	3½	2D	500K	67.5

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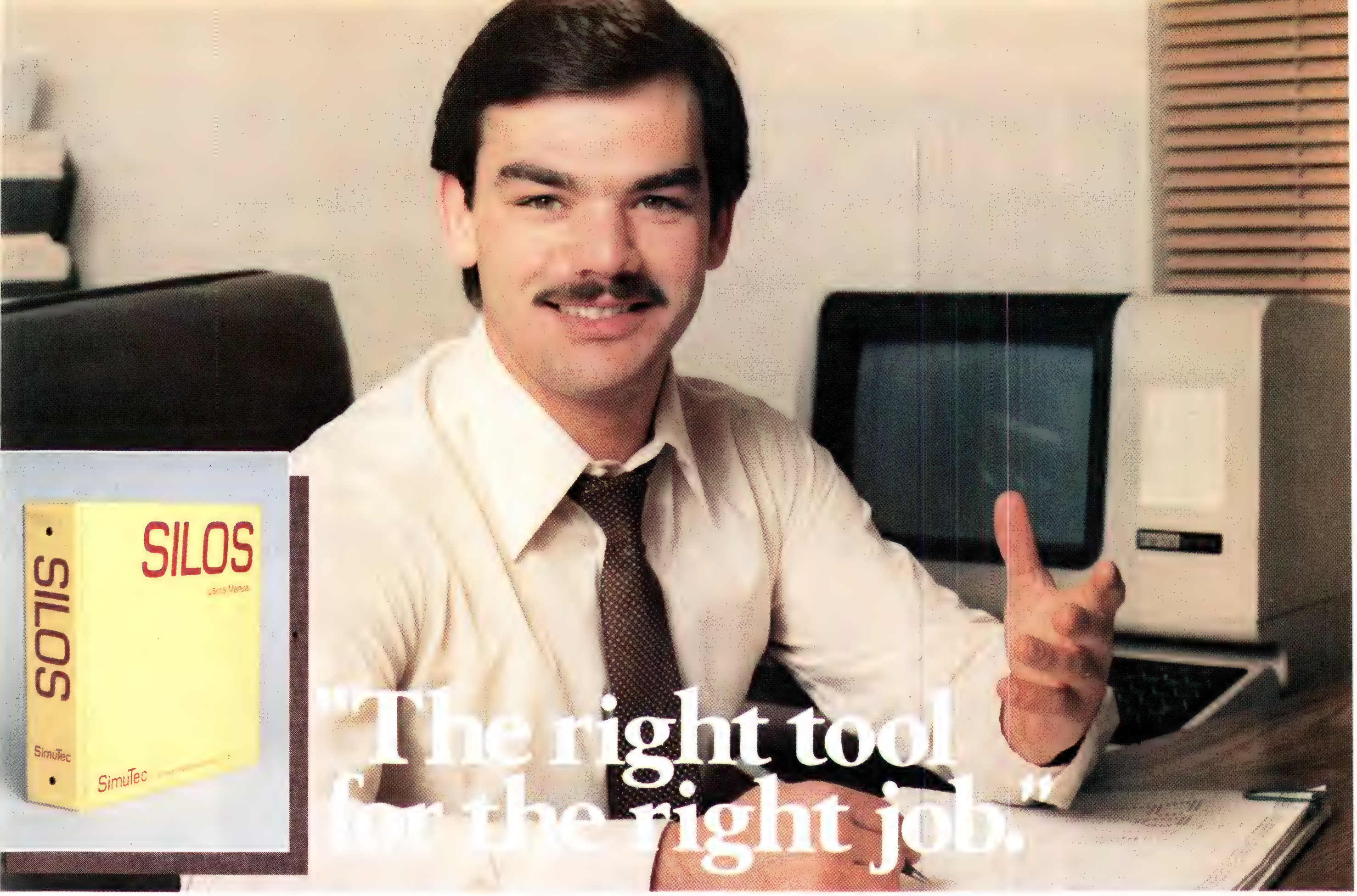
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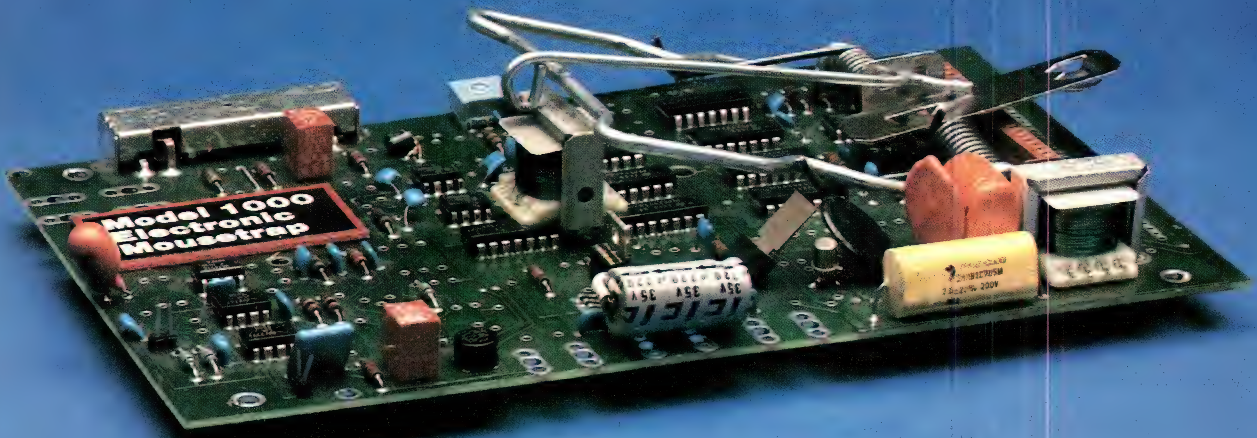
"If you make a better mousetrap, the world will make a beaten path to your door."

Ralph Waldo Emerson, 1855



"If you design a better mousetrap, the world won't necessarily make a beaten path to your door."

ElectronicsWeek, 1984

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This is the first issue of ElectronicsWeek.

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JULY 23, 1984

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ElectronicsWeek

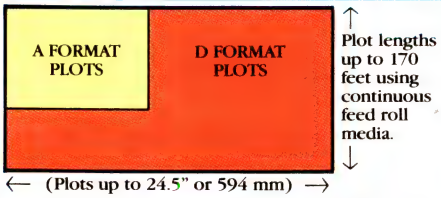
Memory Tester Breakthrough

CAPACITY DOUBLES/162

WORLD MARKETS RIDE A CREST/106

At last. A plotter designed to run both cut sheet and roll media.

The most flexible "D" format 8-pen plotter ever.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D FORMAT PLOTS
Plot lengths up to 170 feet using continuous feed roll media.
(Plots up to 24.5" or 594 mm)

Now you can create virtually any size plots you want up to 24.5" wide, including ANSI sizes A-D and ISO sizes A4-A1, on cut sheet or roll media. Use standard bond paper, glossy bond, vellum, clear film or mylar.

Run dozens of entirely different plots automatically thanks to a built-in microcomputer that can be pre-programmed to plot on roll media up to 170 feet. Then quickly switch to cut sheet plotting – great for your pre-printed forms. The ZETA 822 is the only plotter that can do both.

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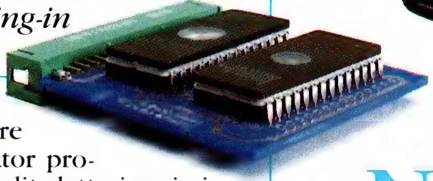
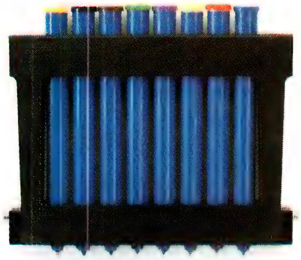
Change character sets just by plugging-in a ROM chip.



Our firmware character generator produces typeset quality lettering similar to the popular Helvetica font with user-controlled proportional spacing. Now you can add special character symbol sets for both engineering and architecture simply by plugging in a new ROM chip.

Eight color, carriage-mounted pens eliminate time-consuming pen changes.



Incredibly, some plotters still grind to a dead stop to change pens. Not ours. We put all eight pens on the carriage. You'll be amazed at what that does for plot throughput. And when you want to use our liquid ink option, just snap in our four-pen cartridge.

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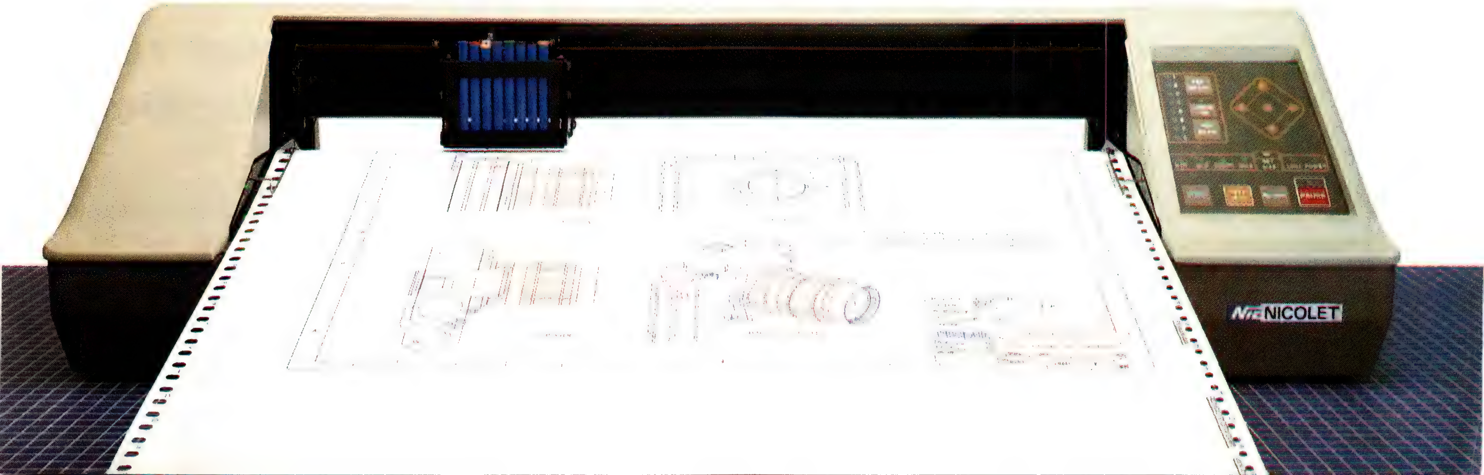

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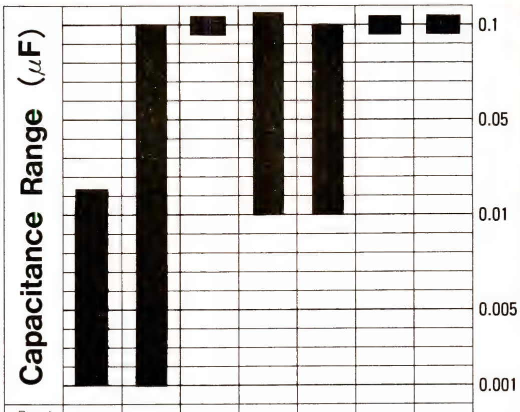

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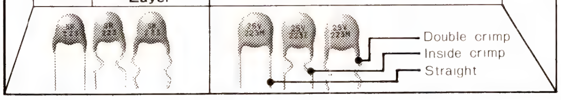

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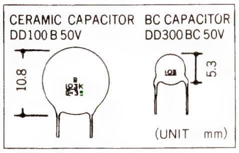

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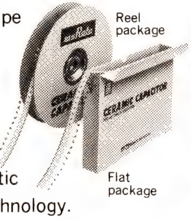

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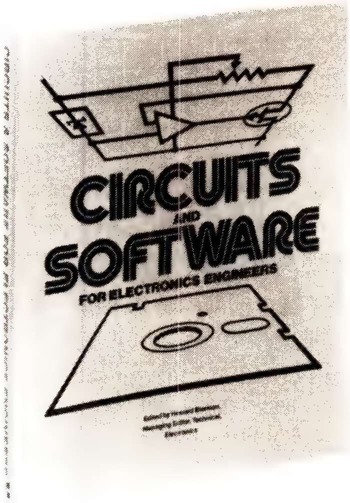

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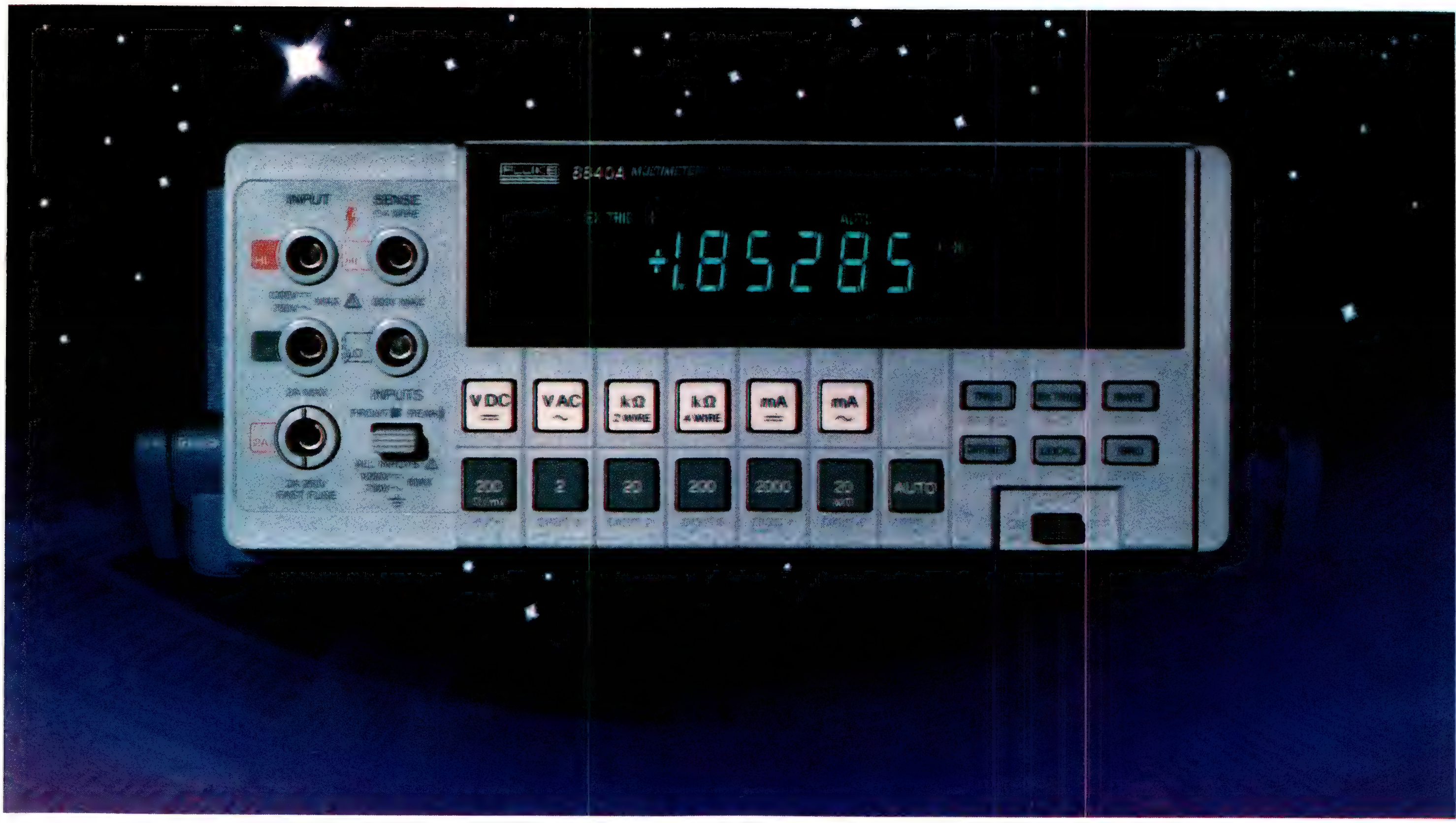

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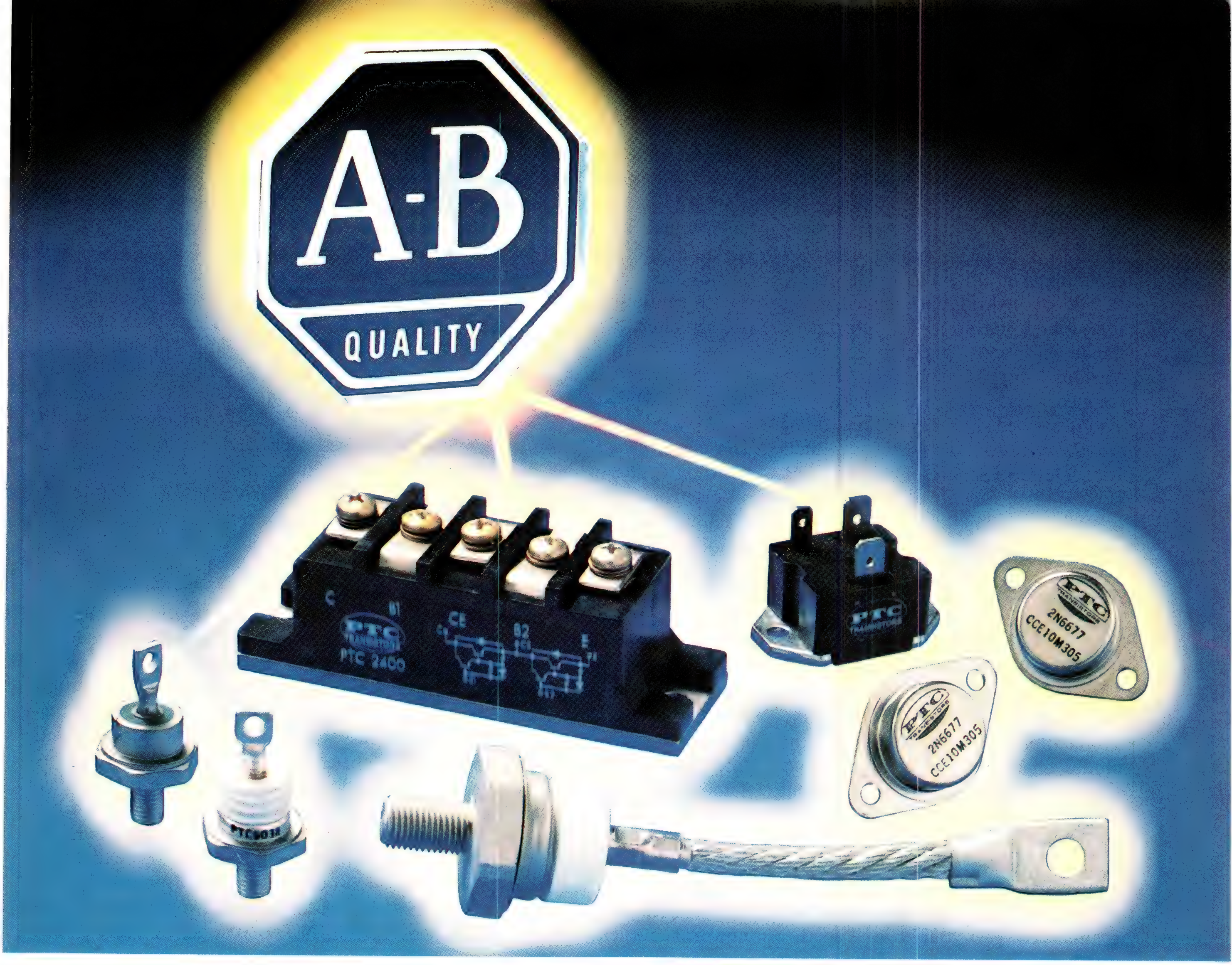

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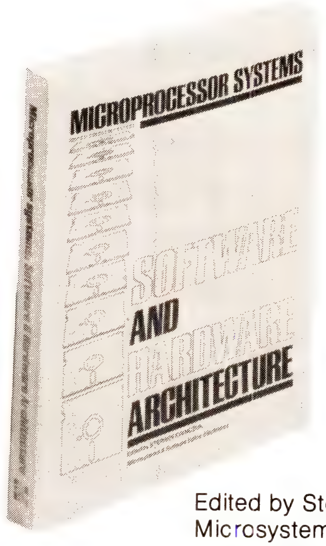

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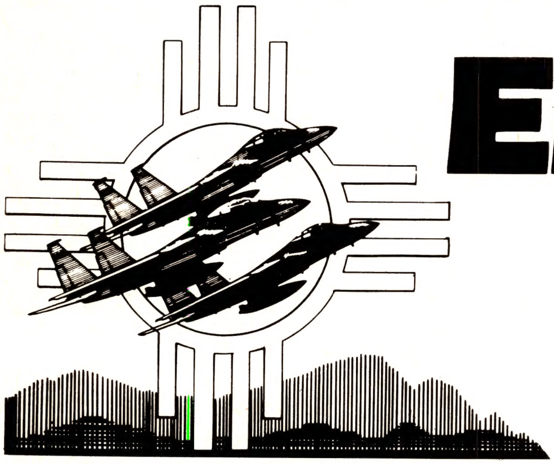

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Requires a BSEE and two or more years' experience in one of the following areas: hardware design of microprocessor-based electronic systems; analog circuit design related to CRT displays; high and low voltage power supplies; and design of programmable symbol generation systems.

- **Analog Design**
- **Electronic Flight Instruments**
- **Programmable Symbol Generators**
- **Software Development**

Helicopter Avionics

Requires a BSEE degree and two or more years' experience in one of the following areas: analog and digital circuit design; test equipment design; human factors/systems design; microprocessor-based systems including I/O, 1553B bus architecture and data processing.

- **Analog and Digital Design**
- **Human Factors**
- **Software Development**
- **Systems Integration**

Flight Control Systems

Requires a BSEE degree and two or more years' experience associated with design of microprocessor-based systems including I/O, data transmission, bus architecture (1553B type) and signal conversion, and analog digital circuit design. Applications include:

- **Flight Management System Development**
- **Analog/Digital Circuit Design**
- **Flight Control System Development**

Engineering Support

Failure Analysis Lab Engineer

Expertise in detailed part failure analysis using sophisticated tools such as microprobes, SEM, and X-ray spectrograph. Familiarity with solid state physics is essential, as is experience in detailed physical analysis.

Environmental Lab Engineer

Experience with vibration and environmental techniques. You will also program and maintain microprocessor controllers as well as schedule and supervise lab activities. Experience in environmental labs and familiarity with MIL-STD-781 and MIL-STD-810 essential.

Components Engineer

Preparation of component specifications and provision of technical liaison between Sperry and component vendors. Need specialists in electrical/electronic and mechanical components.

Reliability Engineer

Performance of circuit stress analysis, reliability prediction and failure mode analysis, and participation in reliability development testing.

EMIC Engineer

You will participate in equipment design, prepare control and test plans and reports and assist in testing. Experience in EMIC testing and planning. Familiarity with MIL-STD-461 and -462 is necessary.

Power Supply Engineer

Assist project groups in the analysis and design of low and high voltage power supplies for high-reliability applications. A working knowledge of MIL-STD-704 and power FET switchmode conversion circuitry is essential.

Each of the above positions requires a BSEE or BS Engineering Physics.

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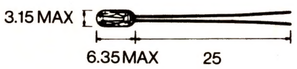

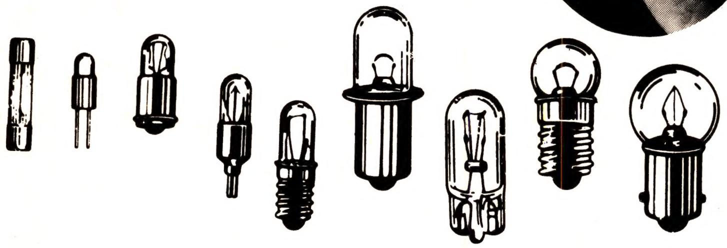

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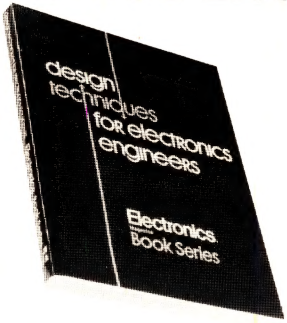

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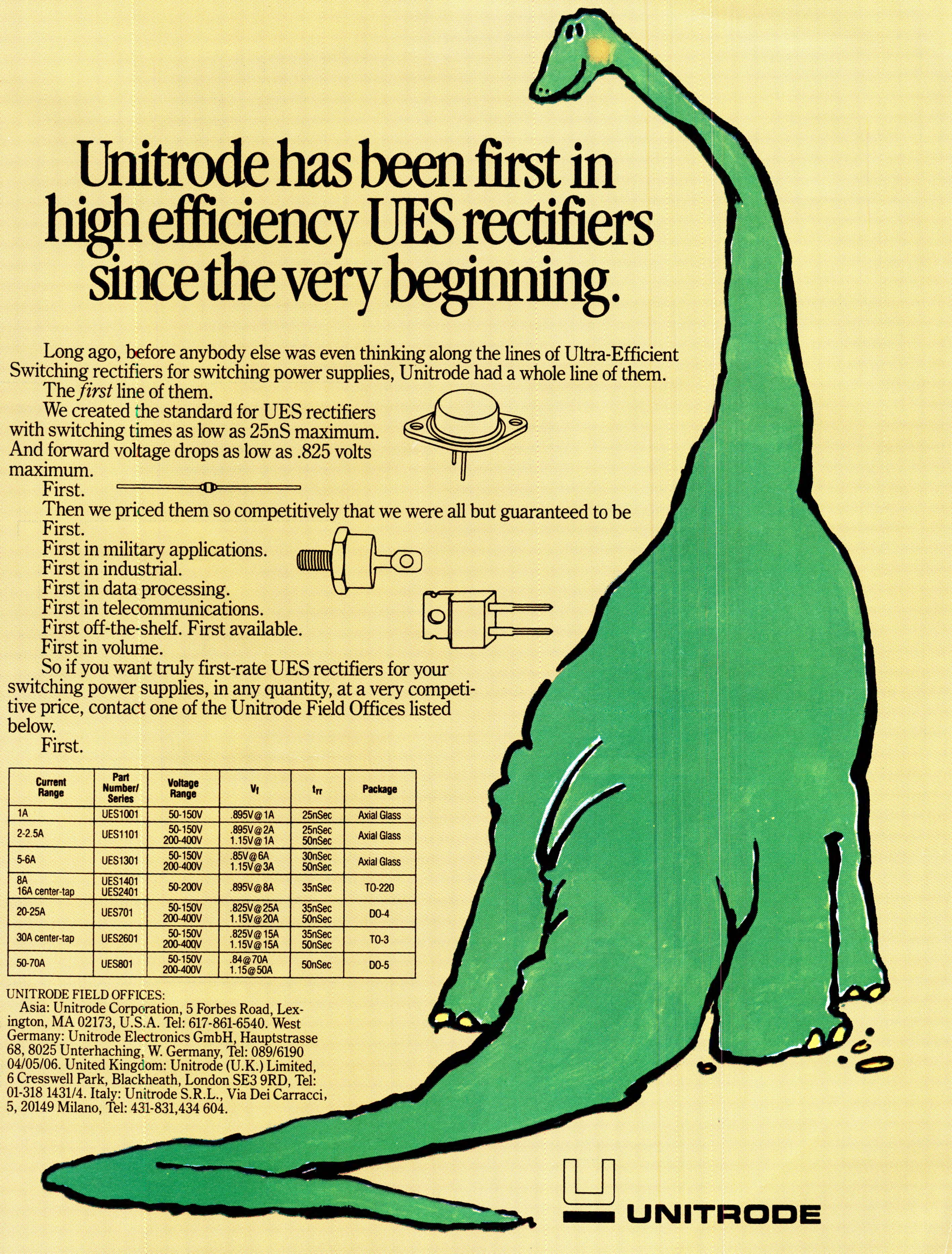

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